REVISION 0

ENVIRONMENTAL MONITORING IMPLEMENTATION PLAN FOR THE NORTH ST. LOUIS COUNTY SITES FOR CALENDAR YEAR 2020

ST. LOUIS, MISSOURI

DECEMBER 23, 2019

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

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

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ACRONYMS AND ABBREVIATIONS

Ac	actinium
AEC	U.S. Atomic Energy Commission
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ATD	alpha track detector
BMP	best management practice
BOD	biological oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COD	chemical oxygen demand
CSR	*Code of State Regulations*
CWC	Coldwater Creek
CY	calendar year
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
ELAP	Environmental Laboratory Accreditation Program
EMDAR	Environmental Monitoring Data and Analysis Report
EMG	*Environmental Monitoring Guide for the St. Louis Sites*
EMICY	Environmental Monitoring Implementation Calendar Year
EMP	Environmental Monitoring Program
FUSRAP	Formerly Utilized Sites Remedial Action Program
Futura	Futura Coatings Company
GASP	Ground-Water Algorithm Sampling Protocol
HISS	Hazelwood Interim Storage Site
HZ	hydrostratigraphic zone
IA	investigation area
IDW	investigation-derived waste
KPA	kinetic phosphorescence analysis
Mallinckrodt	Mallinckrodt LLC
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MSD	Metropolitan St. Louis Sewer District
NC	North St. Louis County
NCP	National Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
Pa	protactinium
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control

ACRONYMS AND ABBREVIATIONS (Continued)

Ra	radium
RA	remedial action
RAC	remedial action contractor
RCRA	Resource Conservation and Recovery Act
RG	remediation goal
Rn	radon
ROD	*Record of Decision for the North St. Louis County Sites*
SAG	*Sampling and Analysis Guide for the St. Louis Sites*
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLS	St. Louis Sites
SOR	sum of ratios
TEDE	total effective dose equivalent
Th	thorium
TLD	thermoluminescent dosimeter
TPH	total petroleum hydrocarbons
TRRA	Terminal Railroad Association
TSS	total suspended solids
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

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.

µCi/mL	microcurie(s) per milliliter
µg/L	microgram(s) per liter
ft	foot/feet
mCi	millicurie(s)
mgd	million gallons per day
mg/L	milligram(s) per liter
mL/L/hour	milliliter(s) per liter per hour
mrem	millirem
NTU	nephelometric turbidity unit(s)
pCi/L	picocurie(s) per liter
WL	working level(s)

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1.0 INTRODUCTION

This Environmental Monitoring Implementation Calendar Year (EMICY) plan for calendar year (CY) 2020 applies to the North St. Louis County (NC) Sites within the Formerly Utilized Sites Remedial Action Program (FUSRAP). Figure 1-1 depicts a schematic representation of the FUSRAP St. Louis Sites (SLS) and shows the overall organization of the NC Sites. The NC Sites consist of the St. Louis Airport Site (SLAPS), its associated vicinity properties (VPs), and the Latty Avenue Properties (Figure 1-2). The Latty Avenue Properties include the Futura Coatings Company (Futura), the Hazelwood Interim Storage Site (HISS), and the Latty Avenue VPs (Figure 1-3).

The FUSRAP was initiated in 1974 by the U.S. Atomic Energy Commission (AEC), the predecessor to the U.S. Department of Energy (DOE). The FUSRAP was transferred to the U.S. Army Corps of Engineers (USACE) on October 13, 1997. The USACE is responsible for the management and execution of the FUSRAP to clean up sites used in the nation's early atomic energy program. One element of the FUSRAP mission is the environmental monitoring of sites at which response actions either are being implemented or have been completed, but at which contaminants remain onsite that exceed *Record of Decision for the North St. Louis County Sites* (ROD) (USACE 2005) remediation goals (RGs) for unlimited use and unrestricted exposure (UUUE).

Environmental monitoring is conducted to support assessment of the effectiveness of the remedial action (RA) in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 5-year reviews. Five-year reviews are required under the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan (NCP), at sites where hazardous substances, pollutants, or contaminants remain above ROD RGs for UUUE. Environmental monitoring serves as a critical tool to evaluate potential future migration of residual contaminants, whether as a component of RAs or as a best management practice (BMP).

This document serves as a component of an integrated approach to collecting environmental data at the NC Sites. These data are collected to ensure compliance with the ROD (USACE 2005) goals and applicable or relevant and appropriate requirements (ARARs). As a result of promulgation of new regulations, issuance of permits, meeting of substantive requirements, and/or the implementation of RAs; monitoring requirements and data objectives for the NC Sites may change. Accordingly, program-level requirements with respect to field sampling procedures, sample management requirements, analytical protocols, and quality assurance (QA)/quality control (QC) activities that are unlikely to change are specified in an upper-tier document titled *Sampling and Analysis Guide for the St. Louis Sites* (SAG) (USACE 2000). The *Environmental Monitoring Guide for the St. Louis Sites* (EMG) (USACE 1999) describes the overall objectives, program structure, media to be monitored, and program requirements of the Environmental Monitoring Program (EMP).

Annual EMICY plans are issued under the EMG to address changing monitoring objectives and to specifically identify sampling locations, frequencies, monitoring parameters, and criteria for evaluation of the resultant data specific for periodic sampling activities for the subject year. Non-periodic sampling activities such as soil sampling to define contamination extent for design purposes or to verify compliance with cleanup objectives or other special studies are specified in other implementation plans throughout the year. Excavation-water and storm-water data obtained from the monitoring described in the EMICY are reported to the U.S. Environmental Protection Agency (USEPA) Region 7 and the Missouri Department of Natural Resources (MDNR) in quarterly reports. The remaining data along with an evaluation of the data obtained from

monitoring under each EMICY during a CY is provided in an annual Environmental Monitoring Data and Analysis Report (EMDAR) for each CY.

Since the completion of the EMICY for CY 2019 (USACE 2018), the USACE added two Coldwater Creek (CWC) surface-water and sediment monitoring and sampling locations (i.e., C010 and C011) downstream from C009 and the Jana School. The USACE is also in the process of moving the USACE St. Louis District FUSRAP Radioanalytical Laboratory from Latty Avenue to the SLAPS and is currently working with the Metropolitan St. Louis Sewer District (MSD) to combine the laboratory's MSD special discharge authorization with the SLAPS treated waste water (i.e., accumulated excavation and ground water) MSD special discharge authorization. Additionally, storm-water sampling at Outfall 002 will continue to vary between annually and monthly based on the status of RA in the drainage area. No other changes to the EMP or environmental monitoring are planned for CY 2020.

The remainder of this section contains a summary description of the contents of this document. Section 2.0 contains guidelines derived from the ROD and various environmental regulations that will be used for assessment of the data obtained under this EMICY. Section 3.0 contains the various types and locations of monitoring to be conducted at the NC Sites, along with supporting QA/QC requirements. Section 4.0 references the SAG procedures necessary to fulfill the requirements of this EMICY, including field-sampling procedures, sample management requirements, sample packaging and shipping requirements, management of investigation-derived waste (IDW), and analytical protocols.

2.0 OBJECTIVES AND EVALUATION GUIDELINES FOR THE ENVIRONMENTAL MONITORING PROGRAM FOR CY 2020

2.1 PROGRAM OBJECTIVES FOR CY 2020

The objectives for the EMP during CY 2020 are identified as follows.

- Conduct BMP monitoring to obtain data for impact evaluations relative to guidelines derived from environmental regulations.
- Conduct periodic monitoring, as required, to meet substantive requirements or permit or ARAR conditions for the NC Sites.
- Perform trend analyses, as required, to determine effects of RAs on surface and ground water.

To fulfill these objectives, Section 3.0 identifies sampling locations and frequencies for various environmental media based on ARARs, permit conditions, site characteristics, risk assessment considerations, and other site factors. Such sampling locations can include the area of contamination (AOC), points of compliance at the AOC boundary, receptor areas, off-site unaffected areas, critical receptors, or migration pathways. Similarly, the monitoring parameters identified in Section 3.0 were selected from permit conditions, best professional judgment based on historical site studies, and the ROD (USACE 2005).

2.2 EVALUATION GUIDELINES FOR ENVIRONMENTAL MONITORING DATA

Data acquired during CY 2020 will be evaluated with respect to ARARs, permit conditions, guidelines derived from environmental regulations, and environmental documents (i.e., the ROD).

2.2.1 Guidelines for Site Radiological Data

Outdoor and indoor air monitoring will be conducted under this EMICY as a BMP or to meet ARAR commitments. Site outdoor radiological monitoring is appropriate in the vicinity of excavation and loadout areas (e.g., VPs) and/or at areas accessible to members of the public. Indoor air monitoring (i.e., radon) is appropriate for occupied or habitable structures at the Futura property at which radium (Ra)-226 levels in soils under structures remain at levels above the RGs established in the ROD. The following subsections describe the monitoring that will be conducted to demonstrate compliance.

Title 40 Code of Federal Regulations (CFR) 61, Subpart I

Sampling results from outdoor airborne particulate monitoring will be evaluated with respect to regulatory guidelines from 40 *CFR* 61. In accordance with 40 *CFR* 61.102(a), the dose from radioactive airborne particulates (excluding radon) to the hypothetical maximally exposed member of the public is not to exceed 10 mrem per year. This value applies to the critical receptor receiving the highest dose as determined by modeling and/or monitoring that considers inputs such as wind direction and duration of human occupancy.

Title 10 CFR 20.1301

Sampling results from outdoor airborne particulate, external gamma, and outdoor radon monitoring conducted at the NC Sites will be evaluated with respect to the regulatory guideline from 10 *CFR* 20. Although this is not an ARAR, the evaluation is conducted as a BMP to provide assurance that actions conducted in accordance with the ROD are protective of the public. Exposure to the public from FUSRAP RA operating activities is limited to 100 mrem per year excluding background, from

all pathways by 10 *CFR* 20. Guidance on the use of monitoring data to demonstrate compliance with the 100 mrem per year standard when considering all pathways is contained in 10 *CFR* 20.

Title 40 CFR 192.12(b)

Sampling results from indoor radon monitoring within occupied structures on the Futura property will be evaluated with respect to the regulatory guideline from 40 *CFR* 192.12(b). In accordance with 40 *CFR* 192.12(b), reasonable effort shall be made to achieve an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WLs in occupied or habitable buildings.

Lists of regulatory commitments and a general description of how the commitments will be implemented are provided in Tables 2-1 through 2-4.

Table 2-1. Guidelines for Outdoor Air, Indoor Air and Direct Radiation Monitoring Data at the NC Sites

Media	Parameter	Regulatory Based Guideline	Type of Monitoring
Outdoor Air	Radiation Dose to Public	Total dose to a member of the public from all pathways ≤100 mrem/year.	Radon concentrations (alpha track detectors [ATDs]), and direct gamma radiation dose rates (thermoluminescent dosimeters [TLDs]) around the loadout pad area for the SLAPS and along the railroad tracks adjacent to Futura on VP-40A.
		Airborne particulate dose to a member of the public ≤10 mrem/year (exclusive of radon).	Air particulate concentrations (filtered air samples) at excavation perimeters and loadout areas accessible to members of the public at the SLAPS, the SLAPS VPs, and the Latty Avenue Properties.
Indoor Air	Radon	Radon progeny concentration (or equivalent) ≤0.02 WL.	Radon measurements (ATDs) within the main structures on the Futura property.

Table 2-2. Summary of National Emission Standards for Hazardous Air Pollutants (NESHAP) Air Emissions at the NC Sites

Regulation: NESHAPs Air Emissions		
Regulation	**Description/Standard**	**Implementation**
40 *CFR* 61, Subpart I (ARAR in ROD [USACE 2005])	Radionuclide emissions of ambient air particulates from federal facilities other than U.S. Nuclear Regulatory Commission (NRC) licensees shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent in excess of 10 mrem/year exclusive of radon.	Compliance with this standard will be demonstrated through measurement of radionuclide air particulate concentrations at site or excavation area perimeters and the use of the USEPA computer code CAP88PC and/or measurement of radionuclide air concentrations at critical receptor locations in accordance with 40 *CFR* 61.107(b). USEPA concurrence is required to use environmental measurements to show compliance at receptor locations.

Table 2-3. Summary of Uranium Mill Tailings Radiation Control Act (UMTRCA) Radon Emissions Regulation

Regulation: UMTRCA Radon Emissions		
Regulation	**Description/Standard**	**Implementation**
40 *CFR* 192.12(b) (ARAR in ROD [USACE 2005])	Indoor radon measurements to ensure the average annual (or equivalent) radon decay product concentration (including background) do not exceed 0.02 WL.	Indoor radon monitoring will be conducted in the main structures on the Futura property using radon ATDs as described in 40 *CFR* 61 Appendix B, Method 114, Method A-7.

Table 2-4. Summary of Regulation for Dose Limits to Individual Members of the Public

Regulation: 10 *CFR* 20.1301 Dose Limits to Individual Members of the Public		
Regulation	**Description/Standard**	**Implementation**
10 *CFR* 20.1301 (BMP)	Total dose to individual members of the public shall not exceed 100 mrem/year, exclusive from the dose contributions from background radiation.	Compliance with this standard will be demonstrated using a combination of TLDs, ATDs, and air samples for particulate radionuclides. Radon concentrations (ATDs), and direct gamma radiation dose rates (TLDs) will be collected around the SLAPS loadout pad area and along the railroad tracks adjacent to Futura on VP-40A. At the SLAPS and the SLAPS VPs, air particulate concentrations (filtered air samples) will be collected at excavation perimeters and loadout areas accessible to members of the public. The summation of the doses calculated from the results of monitoring with TLDs, ATDs, and particulate air samples, as applicable, will be used to demonstrate compliance with the 100 mrem/year criterion. The dose contribution from water pathways is negligible and is not considered when calculating total effective dose equivalent (TEDE) to the critical receptor. Dose from the monitoring locations to critical receptors will be modeled to maximally exposed receptor locations in accordance with 10 *CFR* 20.1302(b)(1) to demonstrate compliance with the dose limit in 10 *CFR* 20.1301.

2.2.2 Guidelines for Excavation-Water Data and Storm-Water Data

The MSD has issued discharge authorization letters for the SLAPS and NC Sites that establish discharge-limit-based criteria for excavation water (MSD 2001, 2005a, 2006b, 2008b, 2010b, 2012b, 2014b, 2016b, 2018b). The pollutants addressed in the MSD letters for the NC Sites are identified in Table 2-5. The pollutants addressed in the National Pollutant Discharge Elimination System (NPDES) permit equivalent for the SLAPS for storm water will be applied at all NC Sites and are identified in Table 2-6. These discharge limits will be used as guidelines for excavation-water and storm-water monitoring data obtained under this EMICY and reported in the annual EMDAR. For cases in which the governing authorities have not provided discharge limits for the NC Sites radiological contaminants of concern (COCs), the 10 *CFR* 20 Appendix B values have been provided. Additionally, the 10 *CFR* 20, Appendix B, values are used to calculate the sum of ratios (SOR) value when sampling for discharge and aid in the establishment of water management protocols. The MDNR has also issued a permit equivalent outlining limits for the storm-water outfalls at the SLAPS (MDNR 1998). The ROD acknowledged effluent limits established in the permit equivalent as ARARs. Copies of the MSD discharge authorization letters and the MDNR NPDES permit equivalent are located in Appendix A of this EMICY.

Table 2-5. NC Sites MSD Discharge Limits and 10 *CFR* 20, Appendix B, Values

Constituent	NC Sites Discharge-Limit-Based Criteria MSD[a]	10 *CFR* 20, Appendix B, Table 3, Sewer Release Values
Radiochemical Parameters		
Ra-226[b]	10 pCi/L	600 pCi/L
Ra-228[b]	30 pCi/L	600 pCi/L
Th-228[b]	2,000 pCi/L	2,000 pCi/L
Th-230[b]	1,000 pCi/L	1,000 pCi/L
Th-232	Not Required	300 pCi/L
U-234	3,000 pCi/L	3,000 pCi/L
U-235	3,000 pCi/L	3,000 pCi/L
U-238	3,000 pCi/L	3,000 pCi/L

Table 2-5. NC Sites MSD Discharge Limits and 10 *CFR* 20, Appendix B, Values (Continued)

Constituent	NC Sites Discharge-Limit-Based Criteria MSD[a]	10 *CFR* 20, Appendix B, Table 3, Sewer Release Values
Radiochemical Parameters (Continued)		
Total U (kinetic phosphorescence analysis [KPA])[b]	No Value Listed	3,000 pCi/L
Gross Alpha (raw water)	3,000 pCi/L	No Value Listed
Gross Beta	No Value Listed	No Value Listed
Gross Alpha (Total Suspended Solids [TSS] filtrate)	No Value Listed	No Value Listed
SOR	1.0	1.0
Total Activity	50 mCi per year	No Value Listed
Metals Parameters		
Barium	10 mg/L	No Value Listed
Lead	0.4 mg/L	No Value Listed
Selenium[c]	0.2 mg/L	No Value Listed
Other Parameters		
Biological Oxygen Demand (BOD)[d]	300 mg/L	No Value Listed
Chemical Oxygen Demand (COD)[d]	600 mg/L	No Value Listed
TSS	No Value Listed	No Value Listed
Total Volume Discharged	100,000 gallons/24-hour period	No Value Listed

[a] MSD authorization letter dated 07/23/01 and as modified in MSD letters issued 02/10/05, 06/19/06, 05/22/08, 05/10/10, 05/24/12, 06/23/14, 07/18/16, and 06/11/18. The first two batches in each new investigation area (IA) will require a full suite analysis. Subsequent batches must be analyzed and shown to meet applicable limits for total U KPA, gross alpha, gross beta, and TSS prior to discharge (MSD 2001, 2005a, 2006b, 2008b, 2010b, 2012b, 2014b, 2016b, 2018b).

[b] These evaluation parameters are used to calculate the SOR value when sampling for discharge and aids in establishing water management protocols.

[c] Under certain conditions with a selenium concentration greater than 0.2 mg/L, a mass limit of 76 grams per day is imposed. This is a special grant from MSD. Any time the selenium levels are greater than 0.2 mg/L, the USACE has the option to discharge at a lower rate. For example, instead of discharging 100,000 gallons of water with selenium concentrations at 0.2 mg/L, the USACE can discharge 50,000 gallons of water at 0.4 mg/L, as long as cumulative discharge of selenium remains below the 76 grams per day (MSD 2005a).

[d] MSD surcharges apply for BOD concentration greater than 300 mg/L and COD concentration greater than 600 mg/L.

2.2.3 Guidelines for Coldwater Creek Surface-Water and Sediment Data

Surface-water and sediment data collected from CWC during this EMICY will be evaluated relative to historical sample results obtained at each station. The ROD states that the maximum contaminant level (MCL) for total uranium (U) of 30 µg/L may be used as a monitoring guide for surface water. In addition, the ROD established RGs for Ra-226, thorium (Th)-230, and U-238, and these criteria will be used in evaluating CWC sediment. A trend analysis will then be performed at each station with the data collected to date to determine the effects of the RA on surface water and sediment in CWC. This trend analysis, along with the sample results, will be reported in the annual EMDAR.

Table 2-6. NC Sites NPDES Discharge Limits and 10 *CFR* 20, Appendix B, Values

Constituent	NC Sites Discharge-Limit-Based Criteria NPDES[a]	10 *CFR* 20, Appendix B, Table 2, Column 2, Effluent Values
Radiochemical Parameters		
Ra-226[b]	Not Required	60 pCi/L
Ra-228[b]	Not Required	60 pCi/L
Total Ra	Monitor Only	No Value Listed
Th-228[b]	Not Required	200 pCi/L
Th-230[b]	Not Required	100 pCi/L
Th-232[b]	Not Required	30 pCi/L
Total Th	Monitor Only	No Value Listed
U-234	Not Required	300 pCi/L

Table 2-6. NC Sites NPDES Discharge Limits and 10 *CFR* 20, Appendix B, Values (Continued)

Constituent	NC Sites Discharge-Limit-Based Criteria NPDES[a]	10 *CFR* 20, Appendix B, Table 2, Column 2, Effluent Values
Radiochemical Parameters (Continued)		
U-235	Not Required	300 pCi/L
U-238	Not Required	300 pCi/L
Total U[b]	Monitor Only	300 pCi/L
Gross Alpha	Monitor Only	No Value Listed
Gross Beta	Monitor Only	No Value Listed
Protactinium (Pa)-231	Monitor Only	6 pCi/L
Actinium (Ac)-227	Monitor Only	5 pCi/L
Radon	Monitor Only	No Value Listed
Metals Parameters		
Arsenic	0.1 mg/L	No Value Listed
Cadmium	0.094 mg/L	No Value Listed
Chromium	0.28 mg/L	No Value Listed
Miscellaneous Parameters		
COD[c]	90 mg/L	No Value Listed
Oil and Grease	10 mg/L[e]	No Value Listed
Total Petroleum Hydrocarbons (TPH)	10 mg/L[e]	No Value Listed
pH[d]	6.0-9.0	No Value Listed
Settleable Solids	1.0 mL/L/hour[e]	No Value Listed
Polychlorinated Biphenyls (PCBs)	<0.5 µg/L	No Value Listed

[a] SLAPS - MDNR NPDES ARAR document letter from MDNR to USACE dated 10/02/98 (MDNR 1998).
[b] These evaluation parameters are used to calculate the SOR value when sampling for discharge and aids in establishing water management protocols.
[c] Sampled annually.
[d] Monitoring only requirement for NPDES or equivalent.
[e] Monthly Average.

2.2.4 Guidelines for Ground-Water Data

The ROD identifies two types of monitoring guidelines: (1) response-action monitoring guidelines and (2) a total-U monitoring guide (which is used for both response-action and long-term monitoring). The ROD guideline for response-action monitoring is two times the 95 percent upper confidence limit (UCL_{95}) of the mean, based on historical concentrations of the analyte in a particular well before soil RAs were initiated under the ROD. The total-U monitoring guide is defined in the ROD to be equal to the total-U MCL of 30 µg/L (USACE 2005).

Response-action monitoring of hydrostratigraphic zone (HZ)-A and Unit 4 of HZ-C (as a surrogate for HZ-E) is conducted to ensure that the soil RA does not significantly degrade current 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 historical 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 RA) 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 soil contaminants remain at levels above the RGs (e.g., at the Futura buildings) to ensure protectiveness of the final remedy and to verify that ground-water conditions do not degrade. In the EMDAR for CY 2020, the NC wells will be evaluated to identify any sustained soil COC concentrations above the respective monitoring guide. If ground-water monitoring indicates the presence of soil COCs at significantly increased concentrations and total U significantly above 30 µg/L, and if significant degrading of CWC surface water may occur, an evaluation of potential response actions would be conducted.

A trend analysis, such as the Mann-Kendall Trend Test, will be performed on wells that meet certain conditions based on their historical data to determine if the soil RA has any significant effects on ground water. The data and results of the trend analyses will be reported in the annual EMDAR.

3.0 ENVIRONMENTAL MONITORING ACTIVITIES FOR CY 2020

This section describes the periodic sampling and analysis selected for CY 2020 to achieve the objectives of the EMP, including the monitoring locations, frequencies, and analytes of concern. These activities will be implemented in conjunction with the program objectives defined in the EMG and program protocols described in the SAG. Details of the specific sampling and analytical protocols necessary for field implementation are provided in the SAG. Characterization efforts, monitoring to support treatability studies, and RA confirmation sampling are considered non-periodic monitoring activities. Non-periodic monitoring activities are outside the scope of the EMICY and are implemented through issuance of work descriptions or other implementation plans and are not described herein.

3.1 AIR MONITORING AND DIRECT GAMMA RADIATION MONITORING

3.1.1 Rationales and Objectives for Air and Direct Gamma Radiation Monitoring

Objectives for air and direct gamma radiation monitoring are identified as follows:

- provide surveillance of public exposure routes through sampling and analysis;
- verify compliance with regulations;
- provide indication and methods to quantify the release of radioactive materials from the site; and
- characterize trends in environmental radiation measurements, especially as they are affected by site RAs.

Measurement objectives to meet regulatory requirements are identified as follows:

- calculate the total effective dose equivalent (TEDE) to the hypothetical maximally exposed members of the public from all complete and applicable pathways;
- calculate the effective dose equivalent from airborne particulate emissions (exclusive of radon) to the hypothetical maximally exposed member of the public;
- determine indoor radon progeny concentrations (or equivalent) in occupied or habitable buildings (e.g., Futura buildings) located on soils exceeding RGs for Ra-226; and
- determine background values for the parameters of concern at off-site locations.

Thermoluminescent dosimeters (TLDs), alpha track detectors (ATDs), and particulate air filters will be used in various combinations at the NC Sites to monitor gamma exposure levels, radon, and airborne particulate radionuclide emissions (exclusive of radon). Data from these measurements will be converted into a TEDE. In compliance with regulatory requirements, an annual NESHAP report will be submitted to the USEPA.

3.1.2 Monitoring Locations

Monitoring locations for TLDs and ATDs at the Latty Avenue Properties are shown on Figure 3-1. The TLD and ATD monitoring locations for the SLAPS are shown on Figure 3-2. Figure 3-3 provides the location of the SLS background gamma radiation, radon, and particulate air sampling stations. The type, frequency, and location of air particulate, radon, and gamma radiation monitoring are identified in Table 3-1. The SLS background sampling results are assumed to be representative of the entire St. Louis metropolitan area including the NC Sites.

Table 3-1. Air Particulate, Radon, and Gamma Radiation Monitoring

Site	Parameters	Media/ Sample Type	Number of Monitoring Locations	Frequency	Driver/Purpose[a]
SLAPS	External gamma radiation	TLD	4	Quarterly	EMP – public exposure
	Radon and progeny	ATD	4	Semi-annually	EMP – public exposure
	Particulate radionuclides	Filter	Varies[b]	During active loadout	EMP – NESHAP/public exposure
SLAPS VPs and Latty Avenue Properties	Particulate radionuclides	Filter	Varies[b]	During active excavations and loadout	EMP – NESHAP/public exposure
Futura Buildings	Radon progeny (or equivalent)	ATD	10	Semi-annually	EMP – UMTRCA/public exposure
VP-40A	External gamma radiation	TLD	2	Quarterly	EMP – public exposure
	Radon and progeny	ATD	3	Semi-annually	EMP – public exposure
Background	External gamma radiation	TLD	1	Quarterly	EMP – public exposure
	Radon and progeny	ATD	1	Semi-annually	EMP – public exposure
	Particulate radionuclides	Filter	1	Weekly	EMP – NESHAP/public exposure

[a] Public exposure monitoring requirements: 40 *CFR* 61, Subpart I; 10 *CFR* 20.1301; 40 *CFR* 192.12(b). Monitoring location levels and/or concentrations are used to calculate TEDE to the hypothetical maximally exposed critical receptor from the site.

[b] The environmental remedial action contractor (RAC) conducts particulate air sampling at appropriate locations around active excavations and loadout areas. These data are used for NESHAP and public exposure evaluations.

External Gamma Monitoring

The TLDs will be used to measure direct gamma exposure from background and residual radioactivity at the NC Sites. The TLDs will be located at the SLAPS loadout area perimeter and along the railroad tracks adjacent to Futura on VP-40A. The QC TLDs will include shipment blanks (to evaluate the exposure received in transit) and duplicate TLDs to evaluate measurement (field) precision.

The TLD locations at the SLAPS will be relatively evenly spaced around the loadout pad area. TLD locations at VP-40A are adjacent to an area with soil under the railroad tracks that exhibit dose rates that are slightly higher than background. No residences are located adjacent to the SLAPS.

A background monitoring location has been selected to measure the background gamma exposure rate. The background TLD monitoring station is currently located at the USACE Service Base on Arsenal Street (see Figure 3-3).

Outdoor Radon Monitoring

The ATDs will be used to measure alpha particle emissions from radon (primarily radon [Rn]-222) and its associated decay products. The radon emissions are expected to increase during RAs such as the loadout of soil. The ATD results are reported as Rn-222 air concentrations in pCi/L and are then converted to dose equivalent.

Locations were chosen with consideration given to predominant wind direction and sources of contamination. Southerly winds predominate from March through November, and northwesterly winds predominate from December through February (Windfinder 2019). The outside locations were selected on all four sides of the loadout pad area for the SLAPS to monitor airborne emissions at points at which the exposure is likely to be highest (see Figure 3-2). The locations for ATDs on VP-40A were selected based on predominant wind directions (see Figure 3-1).

The ATDs will be co-located with the TLDs except for one location on VP-40A. The ATD background monitoring location is currently co-located with the background TLD at the USACE Service Base on Arsenal Street (see Figure 3-3).

Indoor Radon Monitoring

ATDs will be located in four Futura buildings. Three ATDs will be placed inside Buildings #1, #2, and #4, and one will be placed in Building #3. The ATDs will be located in areas that represent the highest likely exposure from indoor radon. The indoor radon monitoring locations at the Futura property are shown on Figure 3-1. Locations have been identified with consideration given to known Ra-226 concentrations under the buildings and personnel occupancy time at any one location in each building. Background indoor radon monitors are not necessary, because the regulatory standard of 0.02 WLs includes background.

Particulate Air Monitoring

Particulate air samplers will be located around active excavation and loadout areas accessible to members of the public at the NC Sites. Air samplers will be placed between the airborne source and areas accessible to members of the public during work activities that disturb soils and have the potential to generate airborne particulates. The locations of these air samplers will be downwind of the work activities. Airborne particulate radionuclide samples will be collected and subsequently analyzed for relevant radionuclides and/or gross alpha and gross beta activity.

The particulate air monitoring stations are expected to be affected mainly during periods of RA when the greatest potential for generation of airborne particulate radionuclide emissions exists. Additional particulate air samplers will be placed around the perimeters of active work zones during RAs. The background air particulate station is currently co-located with the background TLD and ATD stations at the USACE Service Base on Arsenal Street (see Figure 3-3).

3.1.3 Monitoring Frequency

Detectors will remain in place to continuously monitor the environment at the sample locations. The TLDs will be replaced and analyzed every quarter. Radon ATDs (indoor and outdoor) will be replaced and analyzed every 6 months. Stationary particulate air samplers will operate continuously, with samples typically being collected weekly but possibly more frequently because of operational considerations such as dust loading on the filters, which can reduce the sample flow. Excavation and loadout area particulate air samples will operate continuously during active excavation and loadout. The number of samples/measurements and the frequency are identified in Table 3-1.

3.1.4 Field and Laboratory Analyses

Selection of the various monitoring parameters was based on the regulatory requirements with consideration of the radionuclides and their concentrations at each of the NC Sites. The following sections summarize the rationales for analytes and the analysis methods.

Rationale for Analytes

The radionuclides found at the NC Sites are mainly U-series nuclides. Each site has radionuclides in the U-series that may be predominant (such as Ra-226, Th-230, or U-238); thus, each radionuclide must be assessed separately. Therefore, previous soil sampling results from each site have been used to determine source concentration ratios of the individual radionuclides for use in evaluating gross alpha and gross beta air particulate sampling results. Additionally, radon is a component of the U-series nuclides and many radionuclides at the NC Sites emit gamma radiation.

Analysis Methods

Details regarding the analytical testing methods to be used for analysis of TLDs, ATDs, and particulate radionuclide air samples are presented in the SAG for the SLS. Analysis of the various media will be accomplished through purchase orders with qualified laboratories or through analysis at the U.S. Department of Defense (DOD) Environmental Laboratory Accreditation Program (ELAP)-accredited USACE St. Louis FUSRAP laboratory using the laboratory QA plan and standard operating and analysis procedures.

A summary of the type of radiological samples, analysis methods, and target detection levels for the proposed radiological sampling to be completed in CY 2020 is provided in Table 3-2. Justification for the detection levels is based in part on the capabilities of the instrumentation and in part on meeting a lower value than the desired regulatory standard.

Table 3-2. Summary of Laboratory Analysis Methods and Target Detection Levels

Detector/Sample Medium	Analytes Measured	Analysis Method	Target Detection Levels
TLD	Direct external gamma exposure from residual contamination and background	Processed by a qualified vendor	0.1 mrem/quarter
ATD	Airborne Rn-222 and alpha-emitting progeny that originate from Ra-226 (indoor and outdoor)	40 *CFR* 61, Appendix B, Method 114, Method A-7, Rn-222 ATDs	0.2 pCi/L
Particulate Air Filter	Airborne particulate radionuclides: gross alpha and gross beta	40 *CFR* 61 Appendix B, Method 114, Method A-4, Direct Alpha Counting and Method B-4 Gross Beta Counting	3E-15 µCi/mL (gross alpha)[a] 2.E-11 µCi/mL (gross beta)[b]

[a] Based on 10 percent of the 10 *CFR* 20 Appendix B Air Effluent value for Class Y Th-230.
[b] Based on 10 percent of the 10 *CFR* 20 Appendix B Air Effluent value for Class Y Th-234 (Th-234 is a beta emitter in secular equilibrium with U-238).

The TLD target detection level of 0.1 mrem per quarter is approximately 0.3 percent of the annual background dose equivalent rate from external exposure and well below the regulatory limit for members of the public of 100 mrem per year.

The ATD target detection level of 0.2 pCi/L is the level achievable at a qualified vendor laboratory. This level is below the 0.5 pCi/L standard contained in 40 *CFR* 192, Subpart A, for locations outside a site.

A radon progeny level of 0.02 WL is equivalent to a radon concentration of 4.0 pCi/L when radon is in 50 percent equilibrium with its progeny. In an indoor environment, radon is expected to be in approximately 50 percent equilibrium with its progeny. Therefore, the 0.2 pCi/L target detection limit for indoor radon is adequate as compared to 4.0 pCi/L.

The detection level concentrations for uranium and thorium isotopes in particulate air samples are based on three analytical methods found in 40 *CFR* 61, Appendix B, Method 114. Because radionuclide-specific concentrations have already been established, Method A-4, direct alpha counting (gross alpha determination), and Method B-4, direct beta counting (gross beta determination), will be used to routinely evaluate activity levels of samples. These methods will determine alpha activity of the sample without extraction and separation of isotopes. The detection level of 3E-15 µCi/mL for gross alpha, and the detection level of 2E-11 µCi/mL for gross beta will provide adequate minimum detection levels for dose assessment estimates.

Method G-1, high-resolution gamma spectroscopy, will be used as needed to evaluate samples on a case-by-case basis at the qualified vendor laboratory.

3.1.5 Field Quality Control Samples

Two types of QC samples will be collected or used during direct gamma radiation monitoring and environmental radon air monitoring. The types of QC samples include duplicates and transit control samples.

QC Duplicates

Duplicate samples or measurements will be collected using the same protocol and procedures used for obtaining the initial samples and measurements. Duplicate samples/measurements are used to evaluate the field precision of the sampling and measurement process. Duplicate analysis of the same measurement device may be performed at the laboratory to evaluate the reproducibility of the counting technique.

At least one duplicate TLD will be designated at the NC Sites, as applicable, for QC purposes. Duplicate TLDs will be installed, collected, and analyzed at the same time as the sample TLD at that location.

At least one duplicate radon ATD will be designated at the NC Sites, as applicable, for QC purposes. Duplicate ATDs will be placed, collected, and analyzed at the same time as the actual sample at that location.

Transit Control Samples

TLD transit control samples will be used to evaluate the integrated dose to the dosimeter when the dosimeters are not in the monitoring locations. These transit control samples will measure the dose while the dosimeters are in storage and in transit to the processing laboratory.

3.1.6 Equipment and Sampling Methods

3.1.6.1 Equipment

The following sections describe the types of detectors that will be used to quantify radioactive emissions from the NC Sites. The types of detectors and/or sample collection devices include TLDs, ATDs, and airborne particulate samplers.

External Gamma Monitoring

External gamma exposure rates are measured using environmental TLDs (aluminum oxide) housed in polyvinyl chloride (PVC) holders/shelters positioned at the monitoring locations (i.e., at the SLAPS). The TLD shelters are located approximately 3 ft above the ground surface at all monitoring locations. Each TLD measures a cumulative dose over the period of exposure and is expressed in mrem per quarter. The measurements must be corrected for shelter absorption, background, fading, and time of exposure to normalize the measurement to exactly one quarter of exposure.

When exposed to gamma radiation, the TLD stores a portion of the energy. When the TLD is heated, the stored energy is emitted as light that can be amplified, measured, and used to calculate dose equivalent.

Indoor and Outdoor Radon Monitoring

Rn-222 gas concentrations are measured using ATDs that are designed to record alpha emissions within the sensitive element of the detector. These detectors contain film that, when exposed to alpha particles from the radioactive decay of radon, create submicron damage tracks on the film. After exposure, the detectors are returned to the manufacturer for processing. The film is placed in

a caustic etching solution that amplifies the damage tracks, which are counted using a microscope or automated counting system. The number of tracks per unit area is correlated to the radon concentration in the air. ATDs are purchased from various USEPA-approved manufacturers.

Particulate Air Monitoring

Airborne particulate samplers provide a means to collect particulate radionuclides from the ambient air. Low-volume air pumps, with typical flow rates of 30 to 50 liters per minute draw ambient air through a 0.45-micron particulate filter. The filter has a high efficiency for removal of submicron particles. The air pumps are equipped with calibrated measurement devices (i.e., rotameters) to monitor air flow rates. Air flow rates can also be measured externally with portable rotameters. Average flow rates are calculated using before/after sample loading data. At the end of the sample period, the filters are removed from the housing and sent to a laboratory for analyses.

3.1.6.2 Sampling Methods

The following section describes the field sampling methods or direct gamma radiation and air monitoring at the NC Sites. This description is not intended to replace the detailed guidance contained in project instruction guides. The chain-of-custody protocols, sample labeling, identification and shipment procedures, and field logbooks/documentation described in the SAG are applicable to each of the following sampling methods.

External Gamma Monitoring

TLDs will be placed in each ambient-air monitoring station at the beginning of each monitoring period. These TLDs will be replaced and analyzed after approximately 3 months. The location, date of installation, and date of removal for each detector will be logged. A control/background TLD will accompany the exposed dosimeter during shipment to detect any exposure incurred by the dosimeter during shipment.

Indoor and Outdoor Radon Monitoring

Unexposed, preassembled detectors packaged in sealed foil will remain sealed until they are placed in the detector housings. At the time of deployment, the location, date, and type of detector will be recorded. The new, unexposed detector will be placed in the detector housing with the air inlet holes unobstructed. At the end of the exposure period (approximately 6 months), a self-adhering circular seal (available from the manufacturer) will be placed on the exposed detector, covering the air inlet holes. The seals are used to prevent further exposure of the detector from radon or thoron during transport to the laboratory. The removal date will be logged. The exposed detectors will then be packaged in resealable plastic storage bags and submitted to the laboratory.

Particulate Air Monitoring

Siting of the particulate monitoring stations is done carefully so that appropriate measurements of particulate concentrations in an area are collected. During RAs (i.e., active excavation and loadout), additional particulate monitoring may be required at appropriate locations and will be evaluated on a task-by-task basis.

Data collection will consist of logging the sample location, start date, time of sample filter deployment, and the initial flow rate of the air pump. At the end of the sampling period, the stop date, time of sample collection, and final flow rate of the air pump will be logged. If the initial air flow rate is different from the final flow rate, the average of the two values will be used to determine the total flow volume over the sampling period. Calibrated rotameters will be used to establish initial and final flow rates. Rotameters will be calibrated on an annual basis.

As the filter is removed from the filter housing, care will be taken to not disturb the collected particulate. The filter will be placed in a suitable container such that sample integrity is not lost during transport to the laboratory.

The length of time between filter change-out can vary depending on the activities at the site. For example, if no RAs are being conducted, weekly filter change-out is recommended. However, during RAs, more dust could be generated, requiring more frequent filter change-out.

3.1.6.3 Field QC Sampling Procedures

Duplicate samples will be collected in association with the TLD and ATD measurements. Duplicates will be collected using the same equipment and sampling methods as defined in Section 3.1.6.2.

3.1.6.4 Field Decontamination

The sampling techniques described previously consist of one-time-use/dedicated sampling media. Therefore, field decontamination is not required for the samples obtained for direct radiation exposure and air (radon and air particulate) monitoring equipment.

3.2 EXCAVATION-WATER, STORM-WATER, AND LABORATORY DISCHARGE MONITORING

Excavation-water, storm-water, and laboratory discharge monitoring is considered a principal component of the EMICY for the NC Sites. RAs at the sites could result in discharges that are covered under separate discharge requirements. Monitoring will be conducted to meet permit requirements, ARAR permit equivalents, or ROD commitments. Parameters for the NC Sites are listed in Table 3-3, along with sampling locations and frequencies.

The purpose of excavation-water and storm-water discharge sampling is to meet:

- MSD discharge for the SLAPS excavation-water authorization letter dated July 23, 2001 and modified in letters dated February 10, 2005; June 19, 2006; May 22, 2008; May 10, 2010; May 24, 2012; June 23, 2014; July 18, 2016; and June 11, 2018 (MSD 2001, 2005a, 2006b, 2008b, 2010b, 2012b, 2014b, 2016b, 2018b);
- MDNR – NPDES ARARs document (MDNR 1998) dated October 2, 1998, for the NC Sites; and
- MSD authorization letter (February 7, 2018) (MSD 2018a) for the on-site USACE St. Louis FUSRAP laboratory.

Objectives for the NC Sites

The purpose of excavation-water discharge sampling is to meet requirements set forth in the MSD discharge authorization letter dated July 23, 2001, and modified in letters dated February 10, 2005; June 19, 2006; May 22, 2008; May 10, 2010; May 24, 2012; June 23, 2014; July 18, 2016; and June 11, 2018. Copies of these letters are included in Appendix A. The current MSD authorization letter will expire on July 23, 2020, and will be renewed prior to that date (MSD 2018b).

On April 20, 2007, the USACE submitted a letter to MDNR regarding the need for a new outfall for the NC Sites. This letter indicated that the locations of the outfall would vary depending on the location of the RAs (USACE 2007). This outfall is referred to as the "un-named outfall" in Table 3-3.

Table 3-3. Storm-Water, Excavation-Water, Laboratory Waste-Water, Surface-Water and Sediment Monitoring Locations, Frequencies, and Parameters

Site	Monitoring Location	Sample ID/ Outfall	Media/Sample Type	Frequency[a]	Parameters[b]	Driver/ Purpose	Status	Comments
SLAPS[c]	Outfall #002	PN02	Storm Water/Grab	Monthly	List 1	NPDES	Active	RA is anticipated to affect the Outfall 002 drainage area; therefore, the MDNR was notified, and the sampling frequency was increased back to monthly from annually as established in the original permit equivalent agreement (MDNR 1998, 2002).
NC Sites	MSD Sewer	MSD Inlets 10L3-043S and 11K1-036S[d]	Storm Water/Grab	Per Batch	Various[e]	MSD	Active	Sampling is batch-dependent and, therefore, conducted on a non-routine basis. MSD Discharge Letter to the USACE dated July 23, 2001 and letters revised February 10, 2005; June 19, 2006; May 22, 2008; May 10, 2010; May 24, 2012; June 23, 2014; July 18, 2016; and June 11, 2018 (MSD 2001, 2005a, 2006b, 2008b, 2010b, 2012b, 2014b, 2016b, 2018b).
	Un-Named Outfall	Un-Named Outfall	Storm Water/Grab	Per Storm Event	List 1	NPDES	Active	USACE letter from Sharon Cotner addressed to Thomas Siegel dated April 20, 2007 (USACE 2007).
Radioanalytical Laboratory	MSD Sewer	MSD Inlet 10K2-075S	Waste Water/Grab	Per Batch	Various[f]	MSD	Active	Per the discharge authorization letters dated February 7, 2005; February 7, 2006; February 25, 2008; February 1, 2010; January 31, 2012; February 5, 2014; February 2, 2016; and February 7, 2018, samples are collected and analyzed (MSD 2005b, 2006a, 2008a, 2010a, 2012a, 2014a, 2016a, 2018a).
CWC	Location 1 through Location 10	C002 through C011	Surface Water – Sediment	Semi-Annually	List 2	EMP	Active	NA.
	Locations 1, 6, and 8	C002, C007, and C009	Surface Water (High-Flow)	Semi-Annually	List 2	EMP	Active	Sampling will be conducted soon after a precipitation event resulting in high-flow conditions when the surface of CWC measures less than 22.75 ft below the top of the concrete on the north side of the McDonnell Boulevard Bridge.

[a] **Definition of Frequency Lists**
List 1 includes all parameters once per month, and total U, total Ra, total Th, gross alpha, gross beta, Pa-231, Ac-227 – per runoff event, radon – twice per year and COD annually.
List 2 includes COCs – semi-annual.

[b] **Definition of Parameter Lists**
List 1 includes flow (mgd), oil and grease (mg/L), TPH (mg/L), COD (mg/L), settleable solids (mL/L/hour), arsenic (total recoverable) (µg/L), cadmium (total recoverable) (µg/L), chromium (total recoverable) (µg/L), gross alpha (pCi/L), gross beta (pCi/L), polychlorinated biphenyls (µg/L), total Ra (pCi/L and µg/L), total Th (pCi/L and µg/L), total U (pCi/L and µg/L), Pa-231 (pCi/L), Ac-227 (pCi/L), radon (pCi/L), and pH.
List 2 includes radiochemical parameters, metals, and field parameters.
Definitions for Parameters
Radiochemical parameters include Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238.
Metals include antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, and vanadium.
Field parameters for water only include temperature, pH, specific conductance, and oxidation reduction potential and dissolved oxygen.

[c] As of January 2004, sample locations PN01a and PN01b are considered a single discharge point for Outfall #001. As per the USACE letter from Sharon Cotner addressed to Kurt Riebeling dated May 6, 2008, Outfall 001 no longer requires sampling (USACE 2008).

[d] MSD Inlets 10L3-043S and 11K1-036S are the primary discharge locations; however, inlets 10K4-039S, 10K4-049S, 10K4-050S, 10K4-051S, and 10K4-018S may also be used.

[e] Per the 07/23/01 MSD letter, effluent must be tested for Ra-226, Ra-228, Th-228, Th-230, U-234, U-235, U-238, gross alpha, barium, lead, and selenium and meet the following standards: MSD Ordinance 8472; the NRC in 10 *CFR* 20; and Missouri Department of Health Title 19 *Code of State Regulations (CSR)* 20-10 (MSD 2001).

[f] Per the discharge authorization letter, analysis required includes pH, total solids, TSS, COD, cadmium, chromium, copper, iron, lead, nickel, zinc, and the volatile organic priority pollutants. Radionuclides include, gross alpha, gross beta and isotopic Ra, Th, and U (MSD 2005b, 2018a).

As of April 19, 2018, RA was anticipated to affect the Outfall 002 drainage area, the MDNR was notified, and sampling frequency increased back to monthly, from annually, in accordance with the original permit equivalent agreement (MDNR 1998, 2002). When RA is temporarily discontinued in the Outfall 002 drainage area, the MDNR would be notified, and sampling frequency would decrease to annually at Outfall 002. The outfall locations and MSD excavation-water discharge points, with the exception of the un-named outfall location, are shown on Figure 3-4.

The NPDES permit equivalent for storm-water discharges from the NC Sites requires that outfalls be sampled in accordance with the NPDES ARARs document (NPDES permit equivalent). The NPDES ARARs contained in the ROD specify ARAR discharge limits for monitoring purposes at this site. Copies of the MSD discharge authorization letters and the MDNR NPDES permit equivalent are contained in Appendix A.

MSD Permit Renewal for Radioanalytical Laboratory

The USACE owns the radioanalytical laboratory located at 8945 Latty Avenue. The USACE St. Louis FUSRAP laboratory operates under a Special Discharge Authorization Letter granted by MSD (MSD 2005b, 2018a). The MSD authorization letter requires biennial renewal in compliance with discharge regulations (Ordinance 8472, 10177, and 10082). The current MSD authorization letter will expire on February 7, 2020 (MSD 2018a). Prior to that date, the USACE plans to relocate the radioanalytical laboratory from its current location to the SLAPS at 110 McDonnell Boulevard, Hazelwood, Missouri. This action would co-locate the radioanalytical laboratory waste-water (i.e., glassware cleanup waste water, decontamination water, and neutralized isotopic separations waste) discharge point and the SLAPS treated waste-water (i.e., accumulated excavation and ground water) discharge point at the same location. Therefore, the USACE is currently in discussions with the MSD to combine the radioanalytical laboratory and the SLAPS under one MSD special discharge authorization. This action will be reported in the EMDAR for CY 2020, and the new MSD special discharge approval letter will be included in Appendix A of future EMICYs.

The MSD requires analysis of pH, total solids, total suspended solids (TSS), chemical oxygen demand (COD), cadmium, chromium, copper, iron, lead, nickel, zinc, and the volatile organic priority pollutants. Radionuclide analysis includes gross alpha, gross beta, and isotopic Ra, Th, and U constituents. The MSD discharge point for waste water from the USACE St. Louis District FUSRAP laboratory is shown on Figure 3-5.

3.3 SEDIMENT AND SURFACE-WATER MONITORING

Surface-water and sediment samples will be collected along CWC to analyze for the radiological and chemical parameters presented in List 2 of Table 3-3. The physical field parameters will be measured only for surface water as presented in List 2 of Table 3-3.

Objectives for CWC monitoring follow:

- assess the quality of surface water and sediment in CWC;
- compare the sampling results of the COCs to the RGs for sediment in the ROD; and
- evaluate/determine whether runoff from the NC Sites due to RAs is affecting the quality of surface water and sediment in CWC.

Surface-water and sediment samples will be collected from CWC on a semi-annual basis during active RA to determine if the creek is being measurably affected by COC migration

(USACE 2005). The surface-water sampling events will be conducted at the existing 8 CWC monitoring stations (C002 through C009) and 2 newly established stations (C010 and C011), shown on Figure 3-6. Sediment samples will be collected in depositional environments near each of the 10 previously described surface-water locations (C002 through C011) (Figure 3-6). Sampling frequency, along with sampling parameters and locations, are listed along with surface-water information in Table 3-3. This sampling will be conducted at CWC's base flow. Samples will be collected twice per year over a 2- to 3-day period during the first and fourth quarters to obtain representative samples of base-flow water and sediment conditions for the year.

Surface-water samples will also be collected from CWC on a semi-annual basis during high-flow conditions as a BMP to determine if the creek is being measurably affected by COC migration. The high-flow surface-water sampling events will be conducted at an upstream (C002), a midstream (C007), and a downstream (C009) location (Figure 3-6). Sampling frequency, parameters, locations, and surface-water information are listed in Table 3-3. This sampling will be conducted soon after a precipitation event resulting in high-flow conditions when the surface of CWC measures less than 22.75 ft below the top of the concrete on the north side of the McDonnell Boulevard Bridge. Samples will be collected twice per year over a 1- to 2-day period.

3.4 GROUND-WATER MONITORING

3.4.1 Objectives for Ground-Water Monitoring

Ground-water monitoring at the NC Sites will be completed to meet various federal and state requirements.

The purposes of the ground-water monitoring effort are listed as follows:

- identify potential impacts to ground-water quality resulting from RA;
- ensure compliance with ARARs;
- obtain requisite data for CERCLA remedial performance evaluations; and
- determine and monitor background water quality at each of the NC Sites.

The primary objectives and a summary of the hydrogeology of each of the NC Sites are briefly discussed in the following section. A detailed description of the geology and hydrogeology of each site can be found in prior environmental documents and the EMG (USACE 1999).

3.4.1.1 SLAPS and SLAPS VPs Ground-Water Sampling Objectives

The sampling objectives for the SLAPS and the SLAPS VPs include the following:

- evaluate potential ground-water contaminant migration and flow primarily in the upper HZ;
- monitor discharge to CWC to confirm no contaminant migration occurs;
- evaluate potential impacts to ground-water quality in various horizons that may result from RA; and
- provide data necessary for CERCLA evaluations.

Five HZs are recognized beneath the SLAPS (see Figure 3-7). The surficial deposits, consisting of topsoil and anthropogenic fill (Unit 1), and the Pleistocene glacially-related sediments of stratigraphic Unit 2 and Subunit 3T comprise the HZ-A. HZ-B is a clay with low vertical permeability comprising Subunit 3M of stratigraphic Unit 3. HZ-C consists of silty clay, clayey silt, and clayey gravel deposits that make up stratigraphic Subunit 3B and Unit 4. The shale (Unit 5) and limestone (Unit 6) bedrock are recognized as HZ-D and HZ-E, respectively.

The existing ground-water monitoring well network for the SLAPS and the SLAPS VPs is illustrated on Figure 3-8. No wells are planned for decommissioning in CY 2020. The need to decommission wells could arise during the year depending on the RA and its impact on the existing wells.

The methodologies used to determine the parameters analyzed for each monitoring well and the appropriate sampling intervals are described on Figures 3-9 and 3-10, respectively. Ground-water sampling parameters are listed in Table 3-4. The parameters and sampling intervals may be modified based on a review of data as specified on Figures 3-9 and 3-10.

Table 3-4. Ground-Water Monitoring by Site

Site	Parameter[a]	Driver/Purpose
SLAPS and SLAPS VPs	Lists 1, 2, and 3	ROD (USACE 2005)
Latty Avenue Properties	Lists 1, 2, and 3	ROD (USACE 2005)

[a] The methodologies used to determine the parameters analyzed and the appropriate sampling intervals for each monitoring well, are described on Figures 3-9 and 3-10. In addition to the parameters listed here, the USACE may elect to add any parameters identified in the Quality Assurance Project Plan (QAPP) section of the SAG as part of the monitoring (USACE 2000).

Definition for Parameters:

List 1: Radiochemical parameters include Ac-227, and Pa-231, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238.

List 2: Metals include antimony, arsenic, barium, cadmium, chromium, molybdenum, nickel, selenium, thallium, and vanadium.

List 3: Field parameters include pH, specific conductance, oxidation reduction potential, temperature, dissolved oxygen, turbidity, and static water level.

3.4.1.2 Latty Avenue Properties Ground-Water Sampling Objectives

The objectives for ground-water sampling at the Latty Avenue Properties include the following:

- evaluate potential ground-water contaminant occurrence and migration primarily in the upper HZ;
- monitor discharge to CWC to confirm no contaminant migration occurs;
- evaluate potential impacts to ground-water quality in various horizons resulting from previous RA; and
- provide data necessary for CERCLA evaluations.

The hydrogeologic and geologic setting at the Latty Avenue Properties is similar to that at the SLAPS (see Figure 3-7), with one exception. The Pennsylvanian shale bedrock unit (HZ-D) present at the SLAPS is absent at the Latty Avenue Properties.

The current ground-water monitoring well network for the Latty Avenue Properties is identified on Figure 3-11. No monitoring wells are planned for decommissioning at the Latty Avenue Properties in CY 2020.

The methodologies used to determine the parameters analyzed for each monitoring well and the appropriate sampling intervals are described on Figures 3-9 and 3-10, respectively. Ground-water sampling parameters are listed in Table 3-4. The parameters and sampling intervals could be modified based on a review of data as specified on Figures 3-9 and 3-10.

3.4.2 Proposed New Ground-Water Monitoring Wells

As identified in Section 3.4.1, ground-water monitoring will be completed to meet various federal and state requirements. To accomplish these and other ground-water-related objectives, additional wells or well replacements may need to be installed during CY 2020, should conditions change. Specific objectives that could be considered at each site are:

- identify potential impacts to ground-water quality resulting from RA;
- ensure compliance with ARARs;

- obtain requisite data for CERCLA remedial performance evaluations;
- determine or monitor background water quality at each of the sites;
- ensure an adequate monitoring network is established for potentiometric and ground-water-quality monitoring at each key HZ;
- evaluate ground-water contaminant occurrence and migration;
- evaluate the existing monitoring network; and
- replace a decommissioned well.

3.4.3 Rationale for Ground-Water Monitoring

The rationale for the sampling programs established for each site is based on well-analyte history and site-specific requirements and conditions. The rationale for the ground-water monitoring plan correlates with the guidelines identified in Section 2.2.4. At the NC Sites, analytes targeted for monitoring include soil COCs as identified in the ROD (USACE 2005), as well as selected indicator constituents with high mobility that can serve as early indicators of contaminant migration. Analytes may be added to this list at the discretion of USACE.

3.4.4 Field and Laboratory Analyses

Based on previous soil and ground-water sampling conducted at the NC Sites, categories of known or potential ground-water contaminants have been identified for each site. Based on the identified categories, ground-water samples collected at each site will undergo laboratory analytical analysis for the parameters previously identified in Table 3-4. Details regarding the analytical testing methods to be used for chemical analysis of these ground-water samples are presented in the SAG.

Purging and sampling of ground-water monitoring wells will be accomplished using dedicated bladder-type pumps, non-dedicated electric submersible or peristaltic pumps, bailers, or similar equipment. Field measurements of static water level, pH, specific conductance, oxidation-reduction potential, temperature, dissolved oxygen, and turbidity will be recorded during purging and sampling activities.

In cases where ground-water recharge into a monitoring well is rapid, ground-water samples will be collected immediately after completion of purging. However, in cases where recharge is slow, ground-water samples will be collected as soon as sufficient ground water is present in the well. If the volume of the ground-water sample collected from a slow-recharge well is not sufficient to perform both field parameter and laboratory analysis, the entire volume of the sample will be used for laboratory analysis, and field parameter measurements will not be conducted. Ground-water samples collected for analysis of metal, radiological, and water-quality (new wells only) parameters will be collected as unfiltered. The USACE may elect to take both filtered and unfiltered samples at any monitoring well, particularly new wells in which the turbidity is greater than 50 NTUs and existing wells if adverse sampling conditions make it difficult to obtain samples that are free of sediment.

QA/QC Duplicate and Split Samples

In addition to the sampling conducted for the field measurements previously described, duplicate samples and QA split samples will be collected by the USACE during performance of ground-water sampling activities. The monitoring well locations selected for duplicate and split sampling will be random. The exact number of duplicate and split samples collected will depend

on the total number of ground-water samples collected during each quarterly sampling event. One duplicate sample and one split sample will be collected for approximately every 20 ground-water samples collected from the NC Sites. The duplicate and split samples will be analyzed for the same ground-water parameters as the samples collected in accordance with this EMICY. Additional information regarding field QA/QC sampling requirements, and the analytical testing methods to be used for chemical analysis of QA/QC samples, is presented in the SAG.

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4.0 PROGRAM PROTOCOLS

4.1 ORGANIZATION

The USACE St. Louis District will issue an annual EMICY for each CY that defines the program monitoring requirements for the upcoming year with respect to sampling locations, frequencies, monitoring parameters, and the rationale for their selection. Organizational responsibilities for implementation of the EMICY will correspond to those delineated in the SAG (USACE 2000) or other implementation plans. If non-periodic environmental sampling activities are required to meet CERCLA objectives at the NC Sites and if these activities are not discussed in an implementation plan, a work description or final status survey plan that describes the activity-specific requirements will be issued. Each work description or plan will describe responsibilities for its implementation to the extent those roles differ from those specified by the SAG or other implementation guide.

4.2 SAMPLING PROCEDURES

Field sampling procedures for the various media monitored under the EMICY will conform to the requirements specified in the SAG. No unique sampling procedures are required to meet the objectives defined in this annual EMICY.

4.3 SAMPLE MANAGEMENT

Samples collected under this EMICY will be managed in the field, as specified in the SAG. Sample container, preservation, and holding-time requirements for samples collected under the EMICY are also specified in the SAG. Sample documentation requirements, which include the sample numbering system, logbook requirements, and sample labels that pertain to samples collected under the EMG, are presented in the SAG. Chain-of-custody requirements for EMICY samples are also specified in the SAG.

4.4 ANALYTICAL PROTOCOLS

Samples collected under this EMICY will be quantified by the methods specified in the SAG. No unique analytical protocols are necessary to meet the objectives identified in this EMICY.

4.5 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW resulting from implementation of this EMICY will be managed in accordance with the requirements of the USEPA *Guide to Management of Investigation-Derived Wastes* (USEPA 1992). The management of IDW generated from various activities at FUSRAP is outlined in Table 4-1.

Table 4-1. Investigation-Derived Waste Management Options

Waste Type	IDW[a]	Generation Process	Management Option[b]
Water	Ground water	Well development Well sampling and/or purging Other characterization activities	Regulated or Suspect (i.e., Resource Conservation and Recovery Act [RCRA]): containerize and place in storage or treat onsite (i.e., PW45). Non-regulated or non-suspect: purge water, in general for all NC wells except for regulated purge water or wells with known organic contamination (i.e., B53W13S and B53W17S), will be placed on nearby unremediated vegetated ground such that it will not pond or runoff.
	Surface water	Characterization activities	Excess surface water is not anticipated from this activity.
	Decontamination water	Decontamination of equipment	Disposition in controlled area such that it will not pond or run offsite or through an outfall.
Soil	Soils and/or sediment	Drill cuttings Soil sampling	Known or suspect contaminated area: place soil in a contaminated soil pile or other designated location. Known or suspect uncontaminated area: backfill location or spread cuttings around sample location.
Waste	Containerized wastes	Sampling	Return unused portion to original source container.
Sample Equipment	Personal protective equipment	Sample activities Other miscellaneous activities	Reusable: decontaminate. Disposable: dispose of with other radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager or designee.
	Equipment	Sampling equipment Monitoring equipment (swipes, filters, etc.)	Reusable: decontaminate. Disposable: dispose of as radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager or designee.
Laboratory Wastes	Soil, filter papers, test tubes, other radiological trash, etc.	Analysis	Dispose of as radiological trash. If used to sample suspect hazardous wastes, segregate and dispose of as directed by task manager or designee.
	Acid wastes	Analysis	Neutralize with caustic soda at point of generation and store in 55-gallon container.
	Other liquid wastes	Analysis Equipment decontamination	Regulated or suspect regulated: neutralize, containerize, and treat (solidify) radium analysis liquid waste (lead) at generation with Quikrete® or equivalent, rendering it non-hazardous. Dispose of as radiological trash. Non-regulated or non-suspect: containerize and store in designated storage area.

[a] Management and disposition of wastes not listed in this table will be evaluated on case-by-case basis following the referenced USEPA guidance.
[b] Options may be modified on case-by-case basis but will follow the USEPA guidance.

5.0 REFERENCES

MDNR 1998. 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. Letter dated February 19, 2002. From Matthew Sikes, Environmental Specialist, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: Removal of Outfall 003 and Reduced Sampling on Outfall 002.

MSD 2001. 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 FUSRAP Site, 110 McDonnell.

MSD 2005a. Letter dated February 10, 2005. From Roland Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: St. Louis Airport Site File: SD, St. Louis Airport FUSRAP Site, 110 McDonnell.

MSD 2005b. Letter dated February 7, 2005 from Roland Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, 8945 Latty Avenue, Berkeley, Missouri.

MSD 2006a. Letter dated February 7, 2006. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, 8945 Latty Avenue, Berkeley, Missouri.

MSD 2006b. 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, File: SD, St. Louis Airport FUSRAP Site, 9012138501.

MSD 2008a. Letter dated February 25, 2008. From Roland A. Biehl, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, 8945 Latty Avenue, Berkeley, Missouri.

MSD 2008b. 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. Letter dated February 1, 2010. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, 8945 Latty Avenue, Berkeley, Missouri.

MSD 2010b. 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.

MSD 2012a. Letter dated January 31, 2012. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: SD, Hazelwood Interim Storage Site, 8945 Latty Avenue, Berkeley, Missouri.

MSD 2012b. 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. Letter dated February 5, 2014. From Steve Grace, Environmental Assistant Engineer, to Sharon Cotner, USACE FUSRAP Project Manager. Subject: FUSRAP HISS Laboratory Special Discharge Permit Extension. File SD, Hazelwood Interim Storage Site [SOUR057900], 8945 Latty Avenue, Berkeley.

MSD 2014b. 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. Letter dated February 2, 2016. From Steve Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP HISS Laboratory Special Discharge Permit Extension. File SD, Hazelwood Interim Storage Site [SOUR057900], 8945 Latty Avenue, Berkeley.

MSD 2016b. Letter dated July 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. Letter dated February 7, 2018. From Steve Grace, Environmental Assistant Engineer, to Bruce Munholand, USACE FUSRAP Project Manager. Subject: FUSRAP HISS Laboratory Special Discharge Permit Extension. File SD, Hazelwood Interim Storage Site [SOUR057900], 8945 Latty Avenue, Berkeley.

MSD 2018b. Letter dated July 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.

USACE 1999. *Environmental Monitoring Guide for the St. Louis Sites,* St. Louis, Missouri, Final, December 1999.

USACE 2000. *Sampling and Analysis Guide for the St. Louis Sites,* St. Louis, Missouri, Final, September 2000.

USACE 2005. *Record of Decision for the North St. Louis County Sites,* St. Louis, Missouri, Final, September 2, 2005.

USACE 2007. 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 2008. Letter dated May 6, 2008. From Sharon Cotner, USACE FUSRAP Project Manager, to Kurt Riebeling, Water Pollution Control Program, MDNR. Subject: Termination of Sampling at Outfall 001.

USACE 2011. Letter dated October 7, 2011. From Sharon Cotner, USACE FUSRAP Project Manager, to Matthew Jefferson, MDNR. Subject: Hazelwood Interim Storage Site (HISS)/Latty Monitoring Wells.

USACE 2018. *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2019,* St. Louis, Missouri, Revision 0, December 20, 2018.

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

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FIGURES

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APPENDIX A

REGULATORY CORRESPONDENCE

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