Revision 0

COLDWATER CREEK JULY 26, 2022 FLOOD EVENT SAMPLING ACTIVITIES REPORT

FUSRAP North St. Louis County Sites
St. Louis, Missouri

February 27, 2023

Prepared by:
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Hazelwood, Missouri 63042

For:
U.S. Army Corps of Engineers St. Louis District
FUSRAP Project Office
114 James S. McDonnell Boulevard
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Single Award Task Order Contract
Contract Number W912P9-19-D-0011

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Acronyms and Abbreviations

µg	microgram(s)
AEC	U.S. Atomic Energy Commission
cm^2	square centimeters
COC(s)	contaminant(s) of concern
CWC	Coldwater Creek
dpm	disintegrations per minute
EMDAR	*North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report*
EMICY	*Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2022*
EMP	Environmental Monitoring Program
EPA	U.S. Environmental Protection Agency
FSSE	Final Status Survey Evaluation
FSSP	Final Status Survey Plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
HGL	HydroGeoLogic, Inc.
IA	Investigation Area
L	Liter
Laboratory	St. Louis FUSRAP Laboratory
MDC	minimum detectable concentration
MED	Manhattan Engineer District
pCi/g	picoCurie(s) per gram
pCi/L	picoCurie(s) per Liter
Ra	radium
Report	Sampling Activities Report
RG(s)	remediation goals
ROD	Record of Decision
SLAPS	St. Louis Airport Site
SOR_N	net sum-of-ratios
Th	thorium
USACE	U.S. Army Corps of Engineers
U	uranium
VP(s)	Vicinity Property(ies)

1.0 Introduction

At the direction of the U.S. Army Corps of Engineers (USACE), HydroGeoLogic, Inc. (HGL) and the USACE Verification Contractor, Leidos, performed soil, water, and smear sampling along the eastern and western floodplain areas adjacent to Coldwater Creek (CWC) from July 27 through July 30, 2022 (see Figure 1). The purpose of the sampling was to assess whether the historic July 26, 2022 CWC Flood Event (flood event) may have caused the migration and redeposition of Manhattan Engineer District (MED)/U.S. Atomic Energy Commission (AEC) radiological contaminants of concern (COCs) at levels above *Record of Decision for the North St. Louis County Sites, St. Louis, Missouri* (ROD) (USACE, 2005) remediation goals (RGs). This flood event was the result of a precipitation event that delivered a record amount of rain (over 9.0 inches in 15 hours, as reported at the St. Louis Lambert International Airport) to the region (National Weather Service, 2022). Because floodwaters tend to entrain soils and redeposit them in areas adjacent to the creek system (the floodplain), the USACE directed HGL and Leidos to collect samples along sections of CWC that were inundated or appeared to have been inundated by floodwaters during this flood event (see Figures 2A through 2J).

This Sampling Activities Report (Report) documents the results of the sampling that was performed in flooded areas adjacent to CWC from Banshee Road to the Missouri River in North St. Louis County, Missouri (the subject area) (see Figure 1). This segment of CWC is part of the St. Louis Airport Site (SLAPS) Vicinity Properties (VPs) Coldwater Creek Properties and is subject to ROD requirements due to its location within the ROD boundaries, as shown on Figure 2-2 of the ROD.

The sampling activities in the subject area (see Section 2.0) were conducted for the St. Louis Formerly Utilized Sites Remedial Action Program (FUSRAP) in accordance with the ROD. The ROD was developed by the USACE in consultation with the U.S. Environmental Protection Agency (EPA) and the State of Missouri, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, to address MED/AEC contamination through implementation of the Selected Remedy. The Selected Remedy was deemed necessary to protect public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

As defined in the *Final Status Survey Plan for Soils, Structures, and Sediments at the St. Louis FUSRAP Sites, St. Louis, Missouri* (FSSP) (USACE, 2015), the sampling activities at the subject area were performed to obtain sufficient radiological data to evaluate for the potential presence of radiological COCs at levels exceeding ROD remediation criteria. Note that the presence of COCs at concentrations that exceed the ROD remediation criteria in an individual sample or group of samples may not exceed the ROD RGs. The ROD RGs are based on the average concentration of

the SLAPS VPs COCs within the entire population of data above the site background distribution for a 100-square-meter area. The final demonstration that ROD RGs have been met is not within the scope of this Report.

2.0 Sample Collection and Evaluation Methodology

Soil and smear samples were collected from areas adjacent to CWC that were easily accessible and available to the public. Efforts were made during the sampling activities to identify areas where flooding had occurred, and where accumulation of soil from the flood event was evident. The soil and smear sample locations were biased to areas where fine-grained materials (silts and clays) were deposited by the floodwaters as these materials are more likely to harbor radiological COCs. Water samples were collected directly from the creek, both upstream and downstream of two active St. Louis FUSRAP soil remediation areas adjacent to CWC (see Figures 2A and 2B).

2.1 Soil Samples

Numerous flood deposit areas were identified and sampled throughout the subject area (see Figures 2A through 2J and Tables A.1 and A.2 in Appendix A). Surface soil samples were collected from these areas by the sampling crews using pre-cleaned and decontaminated trowels, placed in pre-cleaned and decontaminated bowls, and mixed thoroughly. Once homogenized, the soil samples were placed into sample containers, labeled, and stored in coolers for transport under chain-of-custody to the St. Louis FUSRAP Laboratory (Laboratory). Quality Assurance/Quality Control split and duplicate samples were collected, where flood deposit volumes were sufficient, at a rate of 1 in 20. The Quality Control samples were sent to the Laboratory for analysis of radiological COCs and the Quality Assurance samples were sent to an independent laboratory.

The soil samples that were submitted to the Laboratory were analyzed by gamma and alpha spectroscopy for SLAPS VPs radiological COCs. After completing the analysis, the results were used as the input for interpretation of the analytical results. The gross radiological soil sample results (not corrected for the arithmetic mean site background concentrations) for each sample were imported into a working database. Analytical data tables were then generated (see Table A.3 in Appendix A). This data table contains the gross analytical results and associated net sum-of-ratios (SOR_N) value for each representative surface soil sample (6 inches) after correction for contribution from background. The SOR_N calculations presented in the tables are derived using the following expression from the ROD (USACE, 2005):

$$SOR_{N-surface} = \frac{Ra\text{-}226_N}{5\ pCi/g} + \frac{Th\text{-}230_N}{14\ pCi/g} + \frac{U\text{-}238_N}{50\ pCi/g}$$

Where pCi/g = picoCuries per gram, Ra-226 = radium-226, Th-230 = thorium-230, and U-238 = uranium-238

The calculated SOR_N value for each sample was compared to the ROD RGs to determine if radiological contamination was present. A sample with a SOR_N value greater than 1.0 (SOR_N > 1.0) was assumed to be contaminated.

2.2 Smear Samples

A smear sample or smear (also known as a swipe) is a radiation survey technique used to determine levels of removable surface contamination. A cloth or paper wipe is rubbed over a surface (typically an area of 100 square centimeters [cm^2]), followed by analysis with a calibrated scaler paired with an alpha/beta scintillation detector (U.S. Nuclear Regulatory Commission, 2020). The sampling crews identified several locations adjacent to CWC where floodwaters had inundated publicly accessible areas within the floodplain and left residual soil (typically silts) on various surfaces such as park benches, sidewalks, streets, fencing, and equipment (see Table A.2 in Appendix A, and Appendix B). Once the sampling crews identified the surfaces that were exposed to floodwaters, the individual smears were labeled with the appropriate identification number, logged, and carefully rubbed over the surface being sampled. The samples were then analyzed for alpha and beta/gamma contamination.

The flood event also submerged seven pieces of equipment, either government-owned or rented, that were being utilized for support of the FUSRAP North St. Louis County Sites. This equipment included two excavators, a dozer, a roller, a GeoProbe drill rig, and two fuel storage tanks. In addition to smear samples for removable contamination, total contamination surveys (fixed plus removable) were performed on this submerged equipment. Both alpha and beta/gamma contamination surveys were completed by holding the instrument probe above the surface being scanned and moving the respective probes at a rate of 1 to 2 inches per second. All direct readings for these scans were recorded on "Surface Contamination Survey" forms (see Appendix C).

To determine if radiological contamination was present on the sampled surfaces, the calculated smear sample values, in disintegrations per minute (dpm)/100 cm^2, were compared to the ROD RGs for soil on structures. A result with a value greater than 600 dpm/100 cm^2-alpha or 6,000 dpm/100 cm^2-beta is considered contaminated. The applicable ROD RGs for soil on structures are presented below for comparison purposes:

Actinum-227	400 dpm/100 cm^2
Protactinium-231	1,400 dpm/100 cm^2
Radium-226	15,000 dpm/100 cm^2
Radium-228	7,700 dpm/100 cm^2
Thorium-230	6,900 dpm/100 cm^2
Thorium-232	1,300 dpm/100 cm^2
Uranium-234	17,000 dpm/100 cm^2
Uranium-235	16,000 dpm/100 cm^2
Uranium-238	19,000 dpm/100 cm^2

2.3 Water Samples

As part of the Environmental Monitoring Program (EMP) for the FUSRAP North St. Louis County Sites, surface-water monitoring of CWC is required until the creek and areas adjacent to the creek have been remediated. Part of the EMP requirements is to evaluate for presence of radiological parameters within the surface water of the creek. To achieve this, CWC surface water samples are collected and analyzed for radiological COCs (Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235 and U-238) on a semi-annual basis, in accordance with the *Environmental Monitoring Implementation Plan for the North St. Louis County Sites for Calendar Year 2022* (EMICY) (USACE, 2021, and predecessor versions), to determine if the normal/base-flow conditions of CWC are being affected by COC migration from adjacent remedial excavations. The locations of the 10 monitoring stations are presented in the *North St. Louis County Sites Annual Environmental Monitoring Data and Analysis Report* (EMDAR) *for Calendar Year 2021, St. Louis, Missouri* (USACE, 2022). The results obtained from these surface water samples are used to compare, by trend analysis, with previous results and to calculate total uranium, the latter of which is the only ROD-monitoring guideline for surface water. Beginning in 2019, additional high-flow/high-velocity surface water samples are also being collected from CWC on a semi-annual basis from three of the monitoring stations (CWC002, CWC007, and CWC009).

Surface-water monitoring station CWC002 (see Figure 2A) is located upstream of two St. Louis FUSRAP active remediation areas (Investigation Area [IA]-09: Ballfields and VP-56, see Figures 2A and 2B, respectively), CWC007 is located adjacent to and immediately downstream of the VP-56 area (see Figure 2B), and CWC009 is located approximately 2 miles downstream from the remedial actions (see Figure 2D). Water sampling results from these stations were also tabulated and compared with the base-flow data for the purpose of identifying potential COC migration, through trend analysis, due to high-flow/high-velocity conditions within and adjacent to the creek. Total uranium concentration values were also calculated for both high-flow/high-velocity and base-flow conditions and compared to the maximum contaminant level of 30 micrograms (µg)/Liter (L) as specified in the ROD.

Following the flood event, one unfiltered surface water sample was collected from each of the three monitoring stations CWC002, CWC007, and CWC009. These samples were placed in sample containers and transported under chain-of-custody to the Laboratory in accordance with the EMICY.

Note that this Report only addresses the high-flow surface water samples that were collected following the flood event. For information regarding the semi-annual water sampling results and other surface water samples not discussed herein, refer to the EMDAR.

2.4 Investigation-Derived Waste

Investigation-derived waste generated during the sampling activities was managed in accordance with applicable USACE contractor procedures and the waste minimization guidelines as specified in the FSSP (USACE, 2015). The waste included used smear cloths, decontamination water, disposable personal protective and sampling equipment, and analyzed soil samples and laboratory waste.

3.0 Sample Results and Evaluation

Sampling activities included reviewing aerial photographs, topographic maps, and local news (Fox2now, 2022) accounts to determine the lateral extent of flooding along CWC and the identification of publicly accessible areas for the collection of soil, surface water, and surface smear samples for radiological analysis. Final sample locations were selected by visual identification of recent physical flood remnants (e.g., debris, high-water marks on structures, and floodwater soil deposits). Soil and smear sample locations were then biased to areas where fine-grained materials (silts and clays) were deposited by the recent flooding, as these materials are more likely to harbor radiological COCs. The various sample collection locations are shown on Figures 2A through 2J, and the associated sample logs for the sample locations are included in Appendix C. The analytical results from the collected samples (soil, smears, and water) are presented in Appendix A. The sampling activities began on July 27, 2022 and were completed by July 30, 2022. Additionally, equipment surveys were performed between July 27 and July 29, 2022, on FUSRAP equipment that was submerged during the flood event. The following subsections discuss the results of the flood event sampling efforts.

3.1 Surface Sample Results and Evaluation

As soon as the floodwaters from CWC receded to safe levels, HGL and Leidos sampling crews began collecting surface soil samples and smear samples within the inundated floodplain areas adjacent to CWC. To help expediate the sampling effort, the USACE directed HGL to sample the section of the CWC corridor from Banshee Road to Jana Elementary School, and Leidos to sample the section of the corridor from Jana Elementary School to the Missouri River (see Figure 1). The sampling crews identified numerous flood deposit areas throughout the creek corridor sections. A total of 58 soil samples were collected from surface areas where the floodwaters deposited appreciable amounts of soil, and a total of 218 smear samples were collected from debris and flood-stained areas within the floodplain. Both soil and smear sample locations are depicted on Figures 2A through 2J. Representative photographs from sampled areas are presented in Appendix B, and sample location details are provided on Tables A.1 and A.2 in Appendix A. Copies of the soil sample logs, and smear survey logs, are provided in Appendix C.

As discussed in Section 2.1, soil sampling results were compared to the ROD's surface criteria to determine if radiological COCs were present above RGs. All soil sample analytical results indicated that radiological COC concentrations were below ROD RGs (see Table A.3 in Appendix A). As discussed in Section 2.2, all smear surface samples were analyzed for levels of removable surface radiological contamination. The results for all of the smear samples that were collected were less than the detectors' minimum detectable activity levels for removable radiological contamination (see Table A.4 in Appendix A).

Sampling crews identified seven sample locations within or near the IA-09: Ballfields remediation area that were inundated during the flood event. Smear samples were collected from five of these (locations 26-29, 31-29, 36-29, 31-30, and 1-27), and soil samples were collected from the remaining two locations (SVP259159 and SVP259145) (see Figure 2A). The results for the five surface smear samples were less than the minimum detectable activity levels (see Table A.4 in Appendix A) and the results from the two surface soil samples indicated that radiological COCs were less than ROD RGs (see Table A.3 in Appendix A).

Sampling crews also identified four sample locations near the VP-56 remediation area that were inundated during the flood event. Two of these locations were sampled using smears (locations 21-29 and 16-27), and soil samples were collected from the other two locations (SVP259158 and SVP259148) (see Figure 2B). The results for the two surface smear samples were less than the minimum detectable activity levels (see Table A.4 in Appendix A) and the results from the two surface soil samples indicated that radiological COCs were less than ROD RGs (see Table A.3 in Appendix A).

The soil sample results, including those adjacent to and downgradient from active excavations, did not indicate that migration and redeposition of radiological COCs at concentrations above ROD RGs occurred as a result of the flood event. Similarly, the smear sample results did not indicate that radiological COCs above minimum detectable activity levels were transported by the July 26, 2022 floodwaters and redeposited on downstream surfaces.

3.2 Equipment Smear Sampling Results and Evaluation

As discussed in Section 2.2, seven pieces of government equipment were submerged by the flood event. This equipment was located within and/or immediately adjacent to either the IA-09: Ballfields remediation area or the VP-56 remediation area. Smear samples for removable contamination and direct read measurements for total contamination (fixed plus removable), were performed on the submerged equipment. Sample locations on the submerged equipment were selected by visually identifying areas that were submerged by floodwaters, with emphasis on sampling any identified floodwater deposits (typically silts). The smear sample and direct reading results for each respective piece of government equipment are included in Appendix C.

The smear results for all submerged equipment were less than the minimum detectable activity levels of the instrumentation. The direct readings for the submerged equipment scans indicated that total and removable contamination was not present on the equipment above 600 dpm/100 cm^2 for alpha and 6,000 dpm/100 cm^2 for beta/gamma (see Appendix C). Additionally, direct reading results for total contamination activity levels were less than the clearance levels (American National Standards Institute, 2013), indicating that radiological COCs were not entrained and deposited on the submerged equipment at detectable concentration levels.

3.3 Water Sampling Results and Evaluation

As discussed in Section 2.3, three surface water samples were collected from CWC following the flood event and while the creek was still experiencing high-flow conditions. The results from these samples were used to monitor radiological parameter data for the assessment of COC migration and to calculate total uranium. One unfiltered surface water grab sample was collected and analyzed for radiological parameters from each of the respective high-flow/high-velocity creek monitoring stations: CWC002 (SVP259136), CWC007 (SVP259137), and CWC009 (SVP259138) (see Figures 2A, 2B, and 2D, respectively). The results from these samples have been tabulated and included in Tables A.5-1 and A.5-2 in Appendix A.

Table A.5-2 (Appendix A) is a compilation of the normal/base-flow surface water sample radiological results from March 2011 to the July 2022 flood event. As noted in Table A.5-1 (Appendix A), the radiological results from the flood event for Ra-226, Th-228, and Th-232, in each surface water sample, were below the minimum detectable concentration (MDC) levels of the analysis method, and Th-230 was less than 1.0 picoCurie/Liter (pCi/L). As evident by the results in Table A.5-2, the flood event sample results were comparable to previous/historical normal/base-flow sample results, indicating that radiological COC concentrations did not increase within the creek due to this flood event.

Table A.5-2 (Appendix A) also lists the total uranium values for surface water samples collected during normal/base-flow conditions from March 2011 to the July 2022 flood event. Total uranium is the only ROD guideline for surface-water monitoring and is calculated by summing the concentration values for U-234, U-235, and U-238 (reported in pCi/L) and converting to µg/L. The ROD criterion for total uranium is 30 µg/L (USACE, 2005). The results from the three surface water samples were all significantly less (approximately 15 times lower) than the ROD criterion (see Tables A.5-1 and A.5-2 in Appendix A). These surface water results were comparable to the historical total uranium results, indicating that total uranium concentrations did not increase within the creek due to this flood event.

4.0 Summary and Conclusions

To assess whether the floodwaters from the historic July 26, 2022 flood event may have caused the migration and redeposition of MED/AEC material further downstream, the USACE directed HGL and Leidos to collect soil, smear, and water samples for analysis along publicly accessible sections of CWC that were recently inundated by floodwaters (see Figures 1 through 2J).

The HGL and Leidos sampling teams visually identified multiple areas along the areas of CWC where recent flood deposits (e.g., debris, soil, and watermarks) were evident (see Figures 2A through 2J), and collected 58 soil samples, 218 smear samples, and three (3) surface water samples from areas throughout the 14-mile-stretch of CWC. Additionally, smear samples for removable contamination and direct-read measurements for total contamination (fixed plus removable) were obtained from seven pieces of equipment, either government-owned or rented, that were submerged during the flood event.

- The soil sample results, including those adjacent to and downgradient from active remediation areas, did not indicate that radiological COCs had migrated and been redeposited in downgradient areas at concentrations above ROD RGs (USACE, 2005) as a result of the July 26, 2022 flood event.
- The smear sample results did not indicate that radiological COCs, above minimum detectable levels, were transported by the July 26, 2022 floodwaters and redeposited on downstream surfaces.
- The smear sample results obtained from the submerged equipment did not indicate that radiological COCs were entrained in the July 26, 2022 floodwaters and subsequently deposited on the submerged equipment at detectable levels.
- The water sampling results from the July 26, 2022 floodwaters indicated that total uranium concentrations for the three high-flow surface water samples were approximately 15 times below the ROD criterion concentration value and are at similar concentration values when compared to the historical normal/base-flow total uranium concentration values (see Table A.5-2 in Appendix A). In addition, concentrations of Ra-226, Th-228, and Th-232 were less than the MDC, and Th-230 was less than 1.0 pCi/L. These results are comparable to the normal/base-flow historical results (see Table A.5-1 in Appendix A) and indicate that radiological COCs were not entrained in the floodwaters.

The sampling conducted following the flood event was extensive in design, with the intent to gather sufficient data to assess the migration potential of MED/AEC radiological COCs by flood transportation mechanisms. This sampling event provided a snapshot of an extreme-case scenario, including high flows and near record-high flood levels that inundated active remediation areas. The sampling results described in this Report lead to the conclusion that the July 26, 2022 flood

event did not result in the migration and redeposition of soil with concentrations of radiological COCs above ROD remediation criteria, either within the creek or adjacent floodplain areas.

5.0 References

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FIGURES

Appendix A
Sample Locations and Analytical Data Results

Appendix B
Photolog: July 27 – July 30, 2022 Post-Flood Sampling Areas

Appendix C
Soil Sample Logs and Removable Contamination Smear Surveys

HGL Coldwater Creek Flood Soil Sample Logbook Entries
Leidos Flood Event Soil Sample Logbook Pages
Leidos Radiological Survey Reports – Smear Samples
HGL Surface Contamination Survey Forms – Smear Samples
HGL Surface Contamination Survey Forms – Construction Equipment Surveys