REVISED FINAL

PROGRAMMATIC UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN (UFP-QAPP) ANNEX 19

ENVIRONMENTAL RADIATION MONITORING PROGRAM

July 2025

Submitted By:

U.S. ARMY INSTALLATION MANAGEMENT COMMAND
ATTN: IMSO, Building 2261
2405 Gun Shed Road, Fort Sam Houston, Texas 78234-1223

Submitted To:

U.S. NUCLEAR REGULATORY COMMISSION
Office of Nuclear Material Safety and Safeguards
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LIST OF WORKSHEETS

LIST OF ACRONYMS AND ABBREVIATIONS

ac	Acre
AEC	U.S. Army Environmental Command
CAR	Corrective Action Report
CAS	Chemical Abstract System
CCV	Continuing Calibration Verification
CD	Compact Disc
CFR	Code of Federal Regulations
CoC	Chain-of-Custody
COR	Contracting Officer's Representative
COTR	Contracting Officer's Technical Representative
CPR	Cardiopulmonary Resuscitation
CSM	Conceptual Site Model
DA	Department of the Army
DAC	Derived Air Concentration
DI	Deionized
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DQO	Data Quality Objective
DU	Depleted Uranium
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EOD	Explosive Ordnance Disposal
ERM	Environmental Radiation Monitoring
ERMP	Environmental Radiation Monitoring Plan
FedEx	Federal Express
FTP	Field Technical Procedure
GIS	Geographic Information System
GPS	Global Positioning System
HASL	Health and Safety Laboratory
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ICAL	Initial Calibration
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICS	Interference Check Sample
ICV	Initial Calibration Verification
IDQTF	Intergovernmental Data Quality Task Force
IEC	International Electrotechnical Commission
IMCOM	Installation Management Command
IS	Internal Standard
ISO	International Organization for Standardization
KeV	Kiloelectron Volts
kg	Kilogram
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

MDC	Minimum Dose Concentration
MDL	Method Detection Limit
MeV	Megaelectron Volts
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
NAVSCOLEOD	Naval School Explosive Ordnance Disposal
NCR	Nonconformance Report
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PAERMP	Programmatic Approach for the Preparation of Site-Specific Environmental Radiation Monitoring Plans
pCi/g	Picocuries per Gram
pCi/L	Picocuries per Liter
PMP	Project Management Professional
POC	Point of Contact
PWS	Project Work Statement
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RCA	Radiation Control Area
RL	Reporting Limit
RPD	Relative Percent Difference
RSSO	Radiation Safety Staff Officer
SHSO	Site Health and Safety Officer
SML	Source Material License
SOP	Standard Operating Procedure
SUXOS	Senior Unexploded Ordnance Supervisor
SW	Solid Waste
TA	Training Area
U-232	Uranium-232
U-233	Uranium-233
U-234	Uranium-234
U-235	Uranium-235
U-236	Uranium-236
U-238	Uranium-238
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UXO	Unexploded Ordnance

Note: The above acronym list contains the acronyms used in the Introduction and Worksheets #3 and #5, the Project Organization and QAPP Distribution. All other worksheets contain their own acronym list.

INTRODUCTION

This Programmatic Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) describes the quality assurance (QA), quality control (QC), and additional technical activities that must be implemented to ensure that data collected are of sufficient quality to support the objectives of environmental radiation monitoring (ERM) at all sites covered under the U.S. Army Environmental Center Nationwide Depleted Uranium (DU) Remedial Design Sampling Program and the U.S. Nuclear Regulatory Commission (NRC) amended license (Source Material License [SML] SUC-1593) that authorizes the U.S. Army to possess DU at sites across the United States. The UPF-QAPP also describes field sampling procedures and laboratory protocols for ERM activities, describes the ways in which QA and QC are applied to analytical results, and discusses data management and reporting. The U.S. Army has not determined who will execute the ERM fieldwork and laboratory analyses. Where organization-specific details (e.g., names, telephone numbers) are required, the entries in the UFP-QAPP Worksheets state, "to be determined" or "TBD," and will be established prior to execution of field sampling and laboratory analysis. In some cases, example information is provided.

Background

The Davy Crockett Weapon System was in the U.S. Department of Defense's (DoD) inventory of weapons between 1961 and 1971. The Davy Crockett was a battalion-level, nuclear-capable recoilless weapon used by infantry, armored, airborne, and mechanized divisions. This system consisted of the M28 (Light Weapon), which was deployed between 1961 and 1968, and the M29 (Heavy Weapon), which was used until 1971. This nuclear capable weapon system fired practice projectiles that contained high explosives during training. The M101 20mm spotting round, which was only used with the M28 Light Weapon, was used to verify the aiming point of the weapon system. The spotting rounds emitted white smoke on impact but did not explode. Remnants of the tail assemblies remain at sites where the U.S. Army trained on the weapons system. The M101 was a small (about 8 inches in length and 1-inch diameter) low-speed projectile weighing about 1 pound and containing 6.7 ounces of DU. Unlike modern munitions that use DU as penetrators to defeat enemy armor, the DU in the M101 was used to provide weight sufficient for the spotting round to simulate the flight of the super caliber Davy Crockett projectile. Approximately 75,000 M101 rounds were manufactured. The U.S. Army demilitarized approximately 44,000 of these M101 spotting rounds at the original manufacturing facility (U.S. Army 2011 DCrockettInfo).

The Atomic Energy Commission, NRC's predecessor, gave the U.S. Army a license to make, test and distribute the spotting rounds. Under that license, the U.S. Army distributed the rounds for training. The license expired in 1978, after the U.S. Army had stopped producing and distributing the spotting rounds. In 2005, the U.S. Army found tail assemblies from the spotting rounds at the Schofield Barracks on Oahu. This discovery prompted a review of all sites that trained with the system. The U.S. Army found DU at other sites, including the Pohakuloa Training Area (TA) on the island of Hawaii. Under NRC regulations, the U.S. Army must have a license to possess this material. The U.S. Army applied for a possession-only license in November 2008. The USACE researched the identity of U.S. Army ranges in the United States where the M101 may have been used. Once this records review identified a potential range, USACE conducted site surveys or worked with the local U.S. Army office to determine whether there is evidence that live-fire training with the M101 occurred at a range. The U.S. Army would have conducted training with the Davy Crockett Weapon System at Department of the Army (DA) major and subordinate installations. It was not until 2011 that the U.S. Army identified all of the sites where it used the Davy Crockett system. At that time, NRC and the U.S. Army decided to continue with licensing the two Hawaiian sites and to address the remaining installations through an amendment.

SML SUC-1593 continues to cover the Schofield Barracks and Pohakuloa TA (Hawaii). It now also applies to Forts Benning (Georgia) and Gordon (Georgia), Forts Campbell and Knox (Kentucky), Fort Carson (Colorado), Fort Hood (Texas), Joint Base Lewis-McChord/Yakima Training Center (Washington), Fort Bragg (North Carolina), Fort Polk (Louisiana), Fort Riley (Kansas),

Fort Sill (Oklahoma), Fort Jackson (South Carolina), Fort Hunter Liggett (California), Fort Wainwright (Alaska), and Joint Base McGuire-Dix-Lakehurst (New Jersey). The NRC license allows the U.S. Army to possess up to 12,567 pounds of DU at the sites and limits the amount of DU the U.S. Army can possess at each location. It requires the U.S. Army to comply with NRC regulations and standards for protecting the public and the environment from radiation and is subject to NRC inspections and periodic reviews. The license requires the U.S. Army to have environmental monitoring as well as radiation safety and physical security plans. These requirements are meant to ensure the DU will not pose a future health risk. The license does not authorize the U.S. Army to use the DU or decommission the sites. Any cleanup would require additional review and approval by NRC to ensure that public health and safety will continue to be protected. The amended license will ensure the U.S. Army has done careful studies and developed site-specific plans for environmental monitoring. ERM activities are being conducted at all sites associated with this license to ensure that DU, present within the radiation control area (RCA), does not pose a threat to human health and the environment through inadvertent or unanticipated release or migration.

Programmatic UFP-QAPP for the Environmental Radiation Monitoring Plan

The most recent requirements for ERM sampling were described in the Programmatic Approach for Preparation of Site-Specific Environmental Radiation Monitoring Plans (PAERMP) (U.S. Army 2020). The Environmental Radiation Monitoring Plan (ERMP) for SML SUC-1593 includes installation-specific annexes that provide site-specific and RCA-specific plans in addition to those in the main ERMP document. This Programmatic UFP-QAPP is applicable to all sites and addresses field and analytical requirements that are common and applicable to all sites and RCAs.

This UFP-QAPP is designed to meet the requirements of applicable Federal regulations for SML SUC-1593, particularly NRC regulations specified in Title 10, Code of Federal Regulations (CFR) Part 20, "Standards for Protection against Radiation." This QAPP is designed to meet the overall ERM goals of providing:

A general historical and current perspective of DU activity in various media with details provided in the Site-Specific ERMP Annexes.

Sampling and analytical procedures to be implemeted to provide an accurate indication of the magnitude and extent of any DU release or migration from past operations.

Environmental monitoring activities at Davy Crockett sites include the collection of samples from suitable surveillance locations, described in Site-Specific ERMP Annexes, using appropriate sampling methods, techniques, and analyses to address credible transport pathways.

This UFP-QAPP documents and describes details for the following topics:

- Data quality objectives (DQOs) for the ERM sampling at all sites
- Procedures for field measurements, observations, and sampling of surface water and sediment
- Requirements for the radiological analysis of environmental samples for total and isotopic uranium (uranium-234 [U-234], uranium-235 [U-235], and uranium-238 [U-238]) concentrations
- Action levels and associated corrective actions for surface water and sediment sample results
- Data management activities and reporting requirements for analytical data.

This Programmatic UFP-QAPP was prepared using guidance from the UFP QAPP Optimized UFP-QAPP Worksheets (IDQTF 2012). The UFP-QAPP Manual is a set of consensus documents prepared

by the Intergovernmental Data Quality Task Force (IDQTF) to provide instructions for preparing QAPPs for any environmental data collection operation. The UFP was developed as a joint initiative by the U.S. Environmental Protection Agency (USEPA), DoD, and U.S. Department of Energy (DOE) to ensure that environmental data are of known and documented quality and suitable for their intended uses, and environmental data collection and technology programs meet stated requirements. Other guidance documents used during the preparation of this UFP-QAPP are the DoD Quality Systems Manual (QSM), Version 5.4 (DoD 2021) and U.S. Nuclear Regulatory Commission Regulation (NUREG)-1757 (NRC 2021).

QAPP Worksheets #1 and #2. Title and Approval Page

Project Identifying Information

a. Programmatic UFP-QAPP for the Environmental Radiation Monitoring Program, Annex 19 to the "Environmental Radiation Monitoring Plan for License SUC-1593."

b. Contract No. W912QR-16-D-0003, Delivery Order No. 002

1. Lead Organization

   a. U.S. Army Installation Management Command
   Major David A. Hermann, License Radiation Safety Officer (RSO)

   _____
   Signature, Date

   b. U.S. Army Environmental Command (AEC)
   Guadalupe Gomez, Project Manager

   _____
   Signature, Date

   c. U.S. Army Corps of Engineers (USACE) – Louisville District
   Christopher Coleman, Contracting Officer's Representative

   _____
   Signature, Date

2. Federal Regulatory Agency

   a. U.S. Nuclear Regulatory Commission (NRC) – Headquarters
   Priya Yadav, P.E., Project Manager

   _____
   Signature, Date

3. Investigative Organization

   a. TBD
   TBD, Project Manager

   _____
   Signature, Date

   b. TBD
   TBD, Deputy Project Manager

   _____
   Signature, Date

   c. TBD
   TBD, Quality Assurance Officer

   _____
   Signature, Date

4. Regulatory Program: NRC monitoring requirements specified in Title 10, Code of Federal Regulations (CFR), Section 20.1101 (entitled *Radiation Protection Programs*), 20.1301 (entitled *Radiation Dose Limits for Individual Members of the Public*), 20.1302 (entitled *Compliance with Dose Limits for Individual Members of the Public*), 20.1501 (under *Subpart F–Surveys and Monitoring*), 20.2001 (under *Subpart K–Waste Disposal*), and 20.2103 (entitled *Records of Surveys*)

5. Approval Entity: NRC

6. Plans and reports from previous investigations relevant to this project:

    a. ARCADIS/Malcolm Pirnie. 2011. Final Quality Assurance Project Plan (QAPP), Operational Range Assessment Program Phase II Quantitative Assessment, U.S. Army Garrison Fort Benning, Georgia. Prepared for U.S. Army Environmental Command. September 23.

    b. ARCADIS/Malcolm Pirnie. 2012. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, U.S. Army Garrison Fort Riley, Kansas. Prepared for U.S. Army Environmental Command and U.S. Army Corps of Engineers, Baltimore District. July. FOR OFFICIAL USE ONLY.

    c. Cabrera (Cabrera Services, Inc.). 2014. Final Report: Vegetation Sampling for Depleted Uranium Schofield Barracks, Oahu, Hawaii. Prepared for U.S. Army Corps of Engineers, U.S. Army – Engineering and Support Center, Huntsville. March.

    d. EA (EA Engineering, Science, and Technology, Inc.). 2010. Final Quality Assurance Project Plan, ORAP Phase II Quantitative Assessment, U.S. Army Operational Range Assessment Program, Quantitative Operational Range Assessments, U.S. Army Garrison Fort Hood, Texas. Prepared for U.S. Army Environmental Command. May.

    e. EA. 2011a. Final Site-Specific Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Fort Bragg, North Carolina. Prepared for U.S. Army Environmental Command. April.

    f. EA. 2011b. Final Quality Assurance Project Plan, Phase II Quantitative Assessment, Fort Carson, Colorado. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. March.

    g. EA. 2011c. Final Quality Assurance Project Plan Addendum, Phase II Quantitative Assessment, Fort Carson, Colorado. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. September.

    h. EA. 2011d. Revised Final Site-Specific Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, U.S. Army Garrison Fort Hunter Liggett, California. Prepared for U.S. Army Environmental Command. January.

    i. EA. 2012a. Final Site-Specific Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Donnelly Training Area, Alaska. Prepared for U.S. Army Environmental Command. May.

    j. EA. 2012b. Final Operational Range Assessment Program (ORAP) Phase II Quantitative Assessment Report, U.S. Army Garrison Fort Benning, Georgia. Prepared for U.S. Army Environmental Command and U.S. Army Corps of Engineers – Baltimore District. September.

    k. EA. 2012c. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Fort Carson, Colorado. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. August.

    l. EA. 2012d. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, U.S. Army Garrison Fort Hood, Killeen, Texas. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. September.

m. EA. 2012e. Final Site-Specific Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Fort Knox, Kentucky. Prepared for U.S. Army Environmental Command. September.

n. EA. 2012f. Final Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Fort Polk and Peason Ridge, Louisiana. Prepared for U.S. Army Environmental Command. August.

o. EA. 2012g. Final Operational Range Assessment, Phase II Quantitative Assessment, Joint Base McGuire-Dix-Lakehurst, New Jersey. Version 1.0. Prepared for HQ AFCEE/TDN, Lackland Air Force Base. April.

p. EA. 2012h. Final Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Schofield Barracks Military Reservation, Oahu, Hawaii. Prepared for U.S. Army Environmental Command. July.

q. EA. 2012i. Final Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Yakima Training Center, Washington. Prepared for U.S. Army Environmental Command. March.

r. EA. 2013a. Final Site-Specific Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, Fort Campbell, Kentucky. Prepared for U.S. Army Environmental Command. November.

s. EA. 2013b. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Fort Polk, Louisiana. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. September.

t. EA. 2013c. Final Operational Range Assessment Program, Phase I Qualitative Assessment Report Addendum, Pohakuloa Training Area, Hawaii. Prepared for U.S. Army Environmental Command and U.S. Army Corps of Engineers, Baltimore District. December.

u. EA. 2013d. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Yakima Training Center, Yakima, Washington. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. November.

v. EA. 2014a. Final ORAP Phase II Quantitative Assessment Report, Donnelly Training Area, Alaska, U.S. Army Operational Range Assessment Program, Quantitative Operational Range Assessments. Prepared for U.S. Army Environmental Command. January 24.

w. EA. 2014b. Final Operational Range Assessment Program Phase II Quantitative Assessment Report, Fort Bragg, North Carolina. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. March.

x. EA. 2014c. Final Operational Range Assessment Program Phase II Quantitative Assessment Report, U.S. Army Garrison, Fort Campbell, Kentucky. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. September.

y. EA. 2014d. Revised Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, U.S. Army Garrison Fort Hunter Liggett, Jolon, California. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. January. FOR OFFICIAL USE ONLY.

z. EA. 2014e. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Fort Knox, Kentucky. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. September.

aa. EA. 2014f. Final Quality Assurance Project Plan, ORAP Phase II Quantitative Assessment, U.S. Army Operational Range Assessment Program, Quantitative Operational Range Assessments, Fort Sill, Lawton, Oklahoma. Prepared for U.S. Army Environmental Command. May.

bb. EA. 2014g. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Fort Sill, Oklahoma. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. December.

cc. EA. 2014h. Final Operational Range Assessment Program, Phase I Qualitative Assessment Report Addendum, Joint Base Lewis-McChord, Tacoma, Washington. Prepared for U.S. Army Environmental Command and U.S. Army Corps of Engineers, Baltimore District. March.

dd. EA. 2015. Final Operational Range Assessment Program, Phase II Quantitative Assessment Report, Schofield Barracks Military Reservation, Oahu, Hawaii. Prepared for U.S. Army Corps of Engineers, Baltimore District and U.S. Army Environmental Command. August.

ee. Malcolm Pirnie (Malcolm Pirnie, Inc.). 2009. Final Work Plan Operational Range Assessment Program, Phase II Quantitative Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina. Prepared for U.S. Army Environmental Command. March.

ff. Malcolm Pirnie. 2010. Final Quality Assurance Project Plan, Operational Range Assessment Program, Phase II Quantitative Assessment, U.S. Army Garrison Fort Riley, Kansas. Prepared for U.S. Army Environmental Command. April.

gg. NRC (U.S. Nuclear Regulatory Commission). 2016. Source Materials License Number SUC-1593, Docket No. 040-09083, Reference No. Amendment No. 1. (ML13259A062).

hh. PIKA-PIRNIE (PIKA-PIRNIE JV, LLC.). 2012. Final Addendum to the UFP QAPP ORAP Phase II Quantitative Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, March 2009, Operational Range Assessment Program, Phase II Quantitative Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina. Prepared for U.S. Army Corps of Engineers, Baltimore District. February.

ii. PIKA-PIRNIE. 2014. Final Report Operational Range Phase II Assessment, U.S. Army Garrison Fort Jackson and McCrady Training Center, South Carolina. Prepared for U.S. Army Corps of Engineers, Baltimore District, Army National Guard (ARNG) Directorate, and U.S. Army Environmental Command. January.

jj. U.S. Army. 2015a. Programmatic “Radiation Safety Plan for IMCOM Ranges Affected by M101 Davy Crockett Spotting Round Depleted Uranium.” NRC ADAMS Accession Number ML16004A369. December 31.

kk. U.S. Army. 2015b. Programmatic “Physical Security Plan for U.S. Army Installation Management Command Ranges Affected by Depleted Uranium in M101 Davy Crockett Spotting Rounds.” NRC ADAMS Accession Number ML16004A369. December 31.

ll. U.S. Army. 2020. “Programmatic Approach for Preparation of Installation-specific Environmental Radiation Monitoring Plans.”

mm. USACHPPM (U.S. Army Center for Health Promotion and Preventive Medicine). 2008. Operational Range Assessment Program, Phase II Assessment Report, Fort Gordon, Georgia, No. 38-EH-053B-08. Prepared for U.S. Army Environmental Command. September 8.

nn. USACE (U.S. Army Corps of Engineers). 2007. Annex 00, Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28, Schofield Barracks and Associated Training Areas, Islands of Oahu and Hawaii. U.S. Army Corps of Engineers, St. Louis District. May.

oo. USACE. 2008a. Project Archive Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28. U.S. Army Corps of Engineers, St. Louis District. Draft. January.

pp. USACE. 2008b. Annex 1, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Hood, Texas. Revised, January.

qq. USACE. 2008c. Annex 2, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Benning, Georgia. Revised, March.

rr. USACE. 2008d. Annex 3, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Carson, Colorado. Revised, April.

ss. USACE. 2008e. Annex 4, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Bragg, North Carolina. Revised, May.

tt. USACE. 2008f. Annex 6, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Knox, Kentucky. Revised, June.

uu. USACE. 2008g. Annex 7, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Riley, Kansas. Revised, August.

vv. USACE. 2008h. Annex 8, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Lewis and Yakima Training Center, Washington. Revised, July.

ww. USACE. 2008i. Annex 11, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Polk, Louisiana. Revised, November.

xx. USACE. 2008j. Annex 13, Final Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Greely, Alaska. Revised, October.

yy. USACE. 2009a. Annex 11, Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Dix, New Jersey. Revised Final. April.

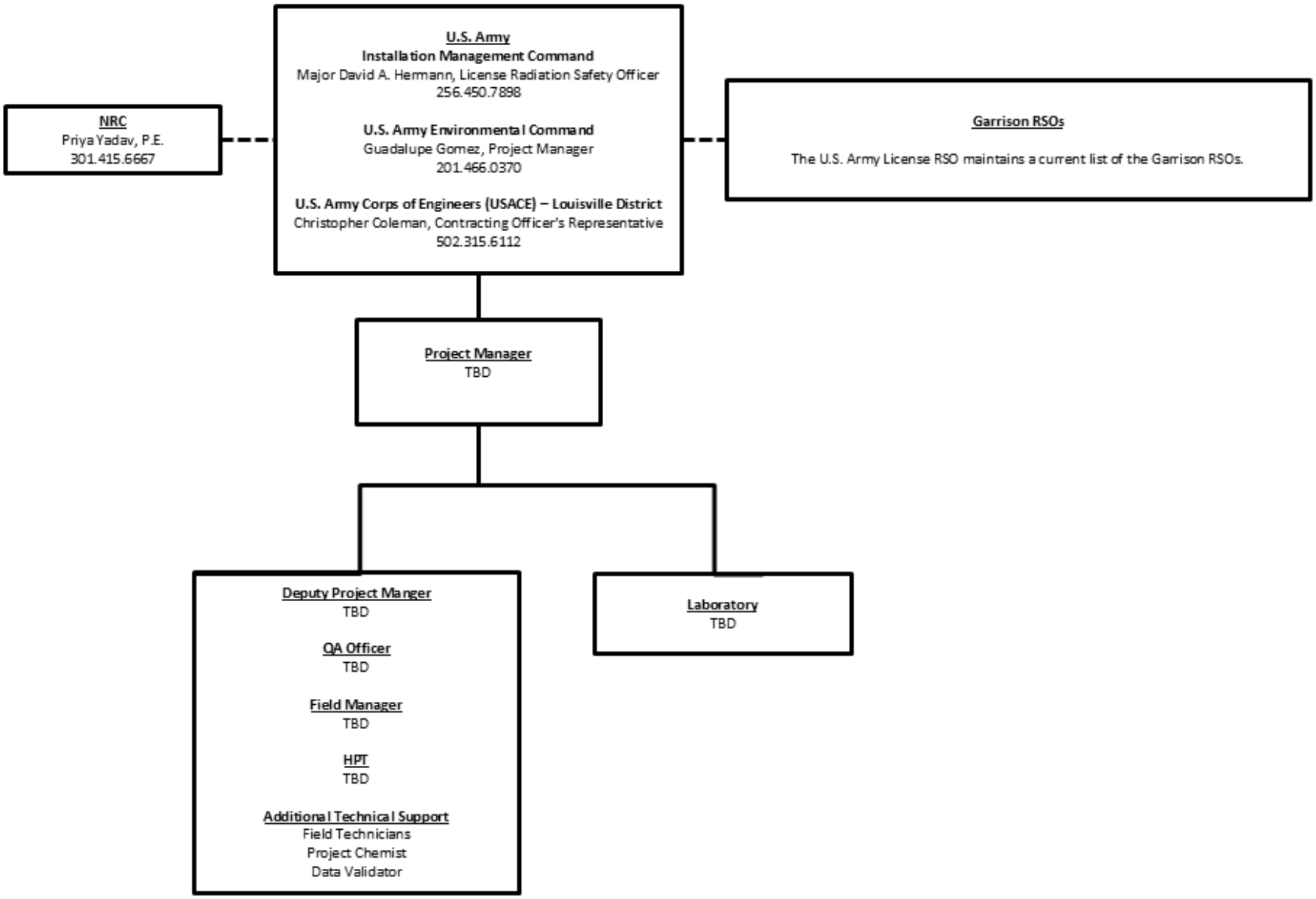
zz. USACE. 2009b. Annex 38, Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Hunter Liggett, California. Revised Final. July.

aaa. USACE. 2009c. Annex 50, Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Jackson, South Carolina. Revised Final. June.

bbb. USACE. 2009d. Final Annex 51, Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Gordon, Georgia. Revised, July.

ccc. USACE. 2009e. Final Annex 53, Installation Specific Archives Search Report on the Use of Cartridge, 20MM Spotting M101 for Davy Crockett Light Weapon M28 at Fort Sill, Oklahoma. Revised, July.

QAPP Worksheets #3 and #5. Project Organization and QAPP Distribution



QAPP Worksheets #4, #7, and #8. Personnel Qualifications and Sign-Off Sheet

Name	Project Title/Role[a]	Education/Experience	Specialized Training/Certifications	Signature/Date[b]
Army/Prime Contractor: Field Execution and Reporting				
TBD	Project Manager			
TBD	Deputy Project Manager			
	Field Manager			
TBD	QA Officer			
TBD	HSO			
TBD	Project Chemist/Data Validator			
Laboratory: TBD				
TBD	Project Manager			
TBD	QA Manager			

[a] All field personnel scheduled for fieldwork at any of the Nationwide DU installations must be trained in accordance with Hazardous Waste Operations 29 Code of Federal Regulations (CFR) 1910.120, 29 CFR 1926.65 and enrolled in a medical surveillance program that meets the requirements of 29 CFR Section 1910.120(f). All personnel must have experience in hazardous waste site work, use of personal protective equipment, and emergency response procedures.
[b] Signatures indicate personnel have read and agree to implement this UFP-QAPP as written.

CFR = Code of Federal Regulations
DU = Depleted Uranium
HSO = Health and Safety Officer
QA = Quality Assurance
QAPP = Quality Assurance Project Plan
TBD = To Be Determined
UFP = Uniform Federal Policy

QAPP Worksheet #6. Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathway, etc.)
Regulatory Agency Interface	IMCOM RSSO/Nationwide DU Program License RSO	Major David A. Hermann	256.450.7898	Signs and sends all license-required, written correspondence originating from the U.S. Army. Leads all written and verbal communications regarding license actions, including termination processes, with NRC.
Regulatory Agency Interface	AEC Project Manager	Guadalupe Gomez	201.466.0370	Supports Nationwide DU Program License RSO in communications with NRC, as requested.
Regulatory Agency Interface	NRC	Priya Yadav	301.415.6667	Leads regulatory reviews and distributes documents submitted by the U.S. Army or designee to other NRC personnel.
Other Agency Interface	USACE COTR	Christopher Coleman	502.315.6112	If project execution is contracted, coordinates U.S. Army input and review for work plan development and access to sampling locations with installation officials by telephone and/or email.
Manage all Project Phases	Project Manager	TBD	TBD	Communicates issues to IMCOM RSSO/Nationwide DU Program License RSO, AEC Project Manager, and USACE COTR, if applicable. Distributes all documents for project to U.S. Army and NRC by mail and/or email.
Reporting Data Quality Issues	QA Officer Project Chemist	TBD	TBD	Reports need for corrective actions or flagging of analytical results to the Project Manager who, depending on severity of issues, reports corrective actions to U.S. Army by telephone and/or email.
Changes to QAPP Prior to Fieldwork	QA Officer Project Chemist	TBD	TBD	Communicates any necessary changes to the QAPP based on data quality prior to fieldwork to the Project Manager by telephone and/or email.
Changes to QAPP During Project Execution	QA Officer Project Chemist	TBD	TBD	Communicates any necessary changes to the QAPP based on data quality during project execution to the Sample Manager and Project Manager by telephone and/or email.
Changes to QAPP Field Sampling Procedures	Project Manager	TBD	TBD	Transmits all changes to QAPP and/or requested changes to field sampling or screening procedures based on field conditions to QA Officer and Project Chemist by telephone and/or email.

QAPP Worksheet #6. Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathway, etc.)
Field Progress Reports	Project Manager	TBD	TBD	Communicates progress made during fieldwork execution to client and regulatory agencies as required by telephone and/or email.
Field Corrective Actions	Project Manager	TBD	TBD	Communicates field-related problems and/or corrective actions identified while in the field to QA Officer and Project Chemist by telephone and/or email.
Stopping Work Due to Health and Safety Issues or Unexpected Field Conditions	Field Manager/Site H&S Manager	TBD	TBD	Ensure all field staff follow approved HASP for fieldwork. All field staff have stop work authority at all times for tasks they are performing or observing.
Reporting Sample Receipt Issues/Data Quality Issues	Laboratory Project Manager	TBD	TBD	Reports all sample receipt and data quality issues to QA Officer or Project Chemist by telephone and/or email as soon as possible after the issues are identified.
Laboratory QC Variances	Laboratory Project Manager	TBD	TBD	Reports all laboratory QC variances to QA Officer or Project Chemist by telephone and/or email as soon as possible after the issues are identified.
Analytical Corrective Actions	Laboratory Project Manager	TBD	TBD	Reports all analytical corrective actions to QA Officer or Project Chemist by telephone and/or email as soon as possible after the issues are identified.
Data Verification Issues, Including Incomplete Records	Laboratory Project Manager	TBD	TBD	Reports all data verification issues including incomplete records to QA Officer or Project Chemist by telephone and/or email as soon as possible after the issues are identified.
Data Validation Issues Including Noncompliance with Procedures or Methods	QA Officer Project Chemist	TBD	TBD	Communicates all data validation issues including noncompliance with procedures or methods to the Project Manager by telephone and/or email as soon as possible after the issues are identified.
Data Review Corrective Actions	QA Officer Project Chemist	TBD	TBD	Communicates any necessary data review corrective actions to the Project Manager by telephone and/or email as soon as possible after the issues are identified.

AEC = U.S. Army Environmental Command
COTR = Contracting Officer's Technical Representative
DU = Depleted Uranium
HASP = Health and Safety Plan
H&S = Health and Safety
IMCOM = Installation Management Command
NRC = U.S. Nuclear Regulatory Commission
QA = Quality Assurance
QAPP = Quality Assurance Project Plan
QC = Quality Control
RSO = Radiation Safety Officer
RSSO = Radiation Site Safety Officer
TBD = To Be Determined
USACE = U.S. Army Corps of Engineers

QAPP Worksheet #9. Project Planning Session Summary

Project Name: Environmental Radiation Monitoring Program **Projected Date(s) of Sampling:** TBD **USACE Technical Manager:** Brooks Evens	**Site Name:** Various (18) Davy Crockett installations – see list below **Site Location:** Various – see list below

Date of Session: 9 June 2016
Location of Session: Teleconference
Scoping Session Discussion: Introduction of the key project participants, review of project requirements and expectations, discussion of proposed deliverables and project schedule for development of site-specific annexes and this QAPP.

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AEC = U.S. Army Environmental Command
COTR = Contracting Officer's Technical Representative
IMCOM = Installation Management Command
QAPP = Quality Assurance Project Plan
RSO = Radiation Safety Officer
TBD = To Be Determined
USACE = U.S. Army Corps of Engineers

Site Names and Locations:

Forts Gordon (Georgia)
Fort Bragg (North Carolina)
Forts Campbell and Knox (Kentucky)
Fort Carson (Colorado)
Fort Jackson (South Carolina)
Fort Hood (Texas)
Fort Hunter Liggett (California)
Fort Polk (Louisiana)
Fort Riley (Kansas)
Fort Sill (Oklahoma)
Fort Wainwright (Alaska)
Joint Base McGuire-Dix-Lakehurst (New Jersey)
Joint Base Lewis-McChord Fort Lewis and the Yakima Training Center (Washington)
Schofield Barracks and Pohakuloa Training Area (Hawaii)

QAPP Worksheet #10. Conceptual Site Model

Introduction

This QAPP addresses the QA, QC, and additional technical activities that must be implemented to ensure that data collected during ERM activities at the Davy Crockett installations are of sufficient quality to support the NRC requirements. The principal objective of ERM activities at all Davy Crockett installations and RCAs is to provide an evaluation of uranium activity in various media, and a timely indication of the magnitude and extent of any DU release or migration offsite from past operations.

NRC issued the U.S. Army's SML SUC-1593 (originally issued in October 2013 for two sites in Hawaii) to possess DU at sites across the country. The March 2016 amendment added 16 installations; the license continues to cover the Schofield Barracks and Pohakuloa TA (Hawaii). It now also applies to Forts Benning and Gordon (Georgia), Fort Bragg (North Carolina), Forts Campbell and Knox (Kentucky), Fort Carson (Colorado), Fort Hood (Texas), Joint Base Lewis-McChord: Fort Hunter Liggett (California), Fort Jackson (South Carolina), Fort Polk (Louisiana), Fort Riley (Kansas), Fort Sill (Oklahoma), Fort Wainwright (Alaska), Fort Lewis and the Yakima Training Center (Washington), and Joint Base McGuire-Dix-Lakehurst (New Jersey). The U.S. Army will apply the same programs for environmental monitoring, radiation safety, and physical security to all sites covered by NRC SML SUC-1593 as issued to CG IMCOM.

The physical security and radiation safety programs are similar to those in the original license. However, the U.S. Army showed, and NRC agreed, that less environmental monitoring is needed because the exposures would be well below the NRC limits even during ground disturbing activities. Separate environmental monitoring plans are required for each of the installations, which generally require limited monitoring of potential routes for transport of contamination out of the impact areas. These plans also include criteria for periodic review to address any changes that may affect risk, tailored to the conditions at each installation. These site-specific plans (see Annexes 1-18) provide detailed information and CSM for each of the sites covered under the license and amendment.

Background Information and Sources of Known or Suspected Hazardous Waste

The license is needed for DU from spotting rounds that were part of the 1960s-era Davy Crockett weapons system. Used for targeting accuracy, the spotting rounds emitted white smoke on impact but did not explode. The spotting round was a low speed projectile weighing about 1 pound and containing 6.7 ounces of DU. Remnants of the tail assemblies may remain at a number of sites where the U.S. Army trained on the weapons system. Under NRC regulations, the U.S. Army must have a license to possess this material. The U.S. Army applied for a possession-only license in November 2008. It was not until 2011 that the U.S. Army identified all of the sites where it used the Davy Crockett system. At that time, NRC and the U.S. Army decided to continue with licensing the two Hawaiian sites and to address the remaining installations through an amendment. A U.S. Army information booklet states that the DU is mostly in large fragments. It is on operational ranges not accessible to the public.

Natural uranium is made up of three isotopes: U-234, U-235 and U-238. "Depleted" uranium has a lower percentage of U-234 and U-235 than natural uranium. DU is about twice as dense as lead, making it useful in commercial and military applications. Uranium in a form that dissolves easily can be toxic to the kidneys if ingested in large amounts, such as by inhaling dust or drinking contaminated water. The DU at the U.S. Army sites is not believed to be in this soluble form. The high density and large fragment size mean the DU cannot easily become airborne or move off site. There is no immediate or imminent health risk to people who work at U.S. Army posts or live in communities adjacent to these military facilities from DU residues from the M101 present in the impact areas. The U.S. Army believes that health effects are unlikely for several reasons:

- Any DU residues from the M101 training operations are limited to impact areas well within the perimeter of operational ranges. Because explosive hazards (i.e., UXO) are normally present on operational range impact areas, public access is generally prohibited and authorized access is strictly controlled. Authorized access is strictly limited to personnel fully trained to recognize the potential hazards associated with military munitions.
- Numerous studies conducted by non-military agencies, including the World Health Organization and the U.S. Department of Health and Human Services, have not found credible evidence linking DU in the environment to radiation-induced illnesses.
- The migration of DU off a military installation by natural processes is highly unlikely. Studies have shown that DU transport is limited and that it is unlikely to move from a range under most conditions. Studies also have shown that the DU fragment size and the environmental conditions on U.S. Army ranges serve to prevent migration, including by air. Nevertheless, the U.S. Army will monitor ranges where there are DU residues from M101 use present, when required to ensure the protection of human health and the environment.

- The U.S. Army conducted an extensive survey at Schofield Barracks covering over 425 acres, which resulted in the collection of over 1,400 air, vegetation, and soil samples that were sent to independent laboratories for testing and analysis. These data were used to perform a risk assessment released in 2008 that concluded that "no adverse human health impacts are likely to occur as a result of exposure to the uranium present in soil."
- The U.S. Army is using this comprehensive analysis along with information concerning the presence of DU at each range and other installation and range-related factors (e.g., land access, adjacent communities) to assess potential health risks posed.

Known/Suspected Contaminants and Class

NRC's criterion is that a U-238/U-234 concentration or activity ratio less than 3.0 is assumed representative of natural uranium, whereas higher ratios are potentially indicative of the presence of DU. All samples with U-238/U-234 activity ratios greater than 3.0 by alpha spectrometry will be reanalyzed using ICP-MS for their U-234, U-235, and U-238 masses in an effort to identify samples with DU content by confirming both the total mass of uranium present in the sample and the mass percent of U-235. These supplemental data are used to augment U-238/U-234 activity information. Given that natural uranium is commonly present in samples with DU and that low activity samples exhibit significant total propagated uncertainty, confirmation that a given sample exhibits DU is often problematic and confirmation by a secondary analytical method often is needed to determine if DU is present. The U-238 to U-234 activity ratio and the weight percent U-235 are used to determine whether a given sample is indicative of natural uranium or DU. The laboratory will use alpha spectrometry to analyze samples for U-234 and U-238 activities in order to comply with license condition #17 in NRC SML SUC-1593. All samples with U-238/U-234 activity ratios exceeding 3.0 will be reanalyzed using ICP-MS for their U-234, U-235, and U-238 masses to identify samples with DU content (NRC 2016). The ICP-MS results for U-234, U-235, and U-238 are summed to calculate a total mass of uranium present (i.e., total uranium), which will be used to calculate the U-235 weight percentage specified in 10 CFR § 110.2 (Definitions) and then to determine if the sample results are indicative of totally natural uranium (at or about 0.711 weight percent U-235) or DU mixed with natural uranium (obviously less than 0.711 weight percent U-235).

Primary Release Mechanism

The original source of DU contamination is M101 spotting rounds fired into an impact area. Upon impact, these rounds remained intact or mostly intact on or near the surface of the RCA. SDADs from AR 385-63 were used to delineate 1,000m x 1,000m target zones/impact areas for M101 spotting rounds. Where the status of individual ranges identified M101 training during the target timeframe (1958 to 1968), the U.S. Army established one or more RCAs for the range, where appropriate. It is not known for any RCA, except for part of the RCA at Schofield Barracks (Cabrera 2013), whether a cleanup or retrieval of these rounds ever occurred, so the assumption is that most, if not all, the DU in rounds fired into an RCA remain in the RCA in some form.

The purpose of the Site-Specific ERMPs prepared as annexes to the PAERMP is to describe the site-specific environmental radiation sampling program to detect M101 spotting round DU leaving the RCA. The plan explains, for a specific RCA, which environmental pathways require evaluation, which samples will be collected for those evaluations, where these samples will be collected, how often these samples will be collected, and how these samples will be analyzed for DU.

Secondary Contaminant Migration

Each Site-Specific ERMP annex will evaluate the potential pathways for DU migration. Per the PAERMP, sampling is not required from within the RCA. Only the sampling of sediment and surface water is planned at the 18 Davy Crockett sites and potential migration will be discussed in the Site-Specific ERMP Annexes.

Fate and Transport Considerations

The type of release affects the magnitude and extent of DU transported through the environment and the potential for exposure of humans and wildlife. The Site-Specific ERMP Annexes will address sediment transport characteristics, erosion transport characteristics and aeolian transport characteristics.

Key Physical Aspects of the Site

Site descriptions can be found in the individual Site-Specific ERMP Annexes, which include information such as climatic conditions, geologic conditions, hydrologic conditions, soil type, sediment transport characteristics, erosion transport characteristics, aeolian transport characteristics, and land use.

Potential Receptors and Exposure Pathways

The transport of DU can be potentially completed along identified pathways to human and/or ecological receptors. Specific details regarding the potential receptors will be discussed in the Site-Specific ERMP Annexes.

Land Use Considerations

Specific details regarding land use considerations will be discussed in the Site-Specific ERMP Annexes.

QAPP Worksheet #10. Conceptual Site Model (Continued)

Nature and Extent of Contamination Discussion of nature and extent of suspected DU present within the RCAs can be found in Section 4 of the individual site-specific ERMP Annexes.
Data Gaps and Uncertainties The primary data gap/uncertainty associated with each Davy Crockett site/installation is the concentration of uranium isotopes in surrounding environmental media over time.

AR = Army Regulation
CFR = Code of Federal Regulations
CG = Command General
CSM = Conceptual Site Model
DU = Depleted Uranium
ERM = Environmental Radiation Monitoring
ERMP = Environmental Radiation Monitoring Plan
ICP-MS = Inductively Coupled Plasma/Mass Spectrometry
IMCOM = Installation Management Command
NRC = Nuclear Regulatory Commission
PAERMP = Programmatic Approach for Preparation of Site-Specific Environmental Radiation Monitoring Plans
QA = Quality Assurance
QAPP = Quality Assurance Project Plan
QC = Quality Control
RCA = Radiation Control Area
SDAD = Safety Danger Area Diagram
SML = Source Material License
TA = Training Area
U-234 = Uranium-234
U-235 = Uranium-235
U-238 = Uranium-238
UXO = Unexploded Ordnance

QAPP Worksheet #11. Project/Data Quality Objectives

This worksheet documents the seven steps of the USEPA DQO process (USEPA 2006) for the collection and analysis of the ERM samples (surface water and sediment) and subsequent reporting, with specifics regarding sample locations and rationale provided in the Site-Specific ERMP Annexes.

Step 1: State the Problem:

NRC requires the U.S. Army to determine whether DU is migrating from RCAs. The License RSO is to determine the ratio of U-238 activity to U-234 activity in environmental samples from radiochemistry laboratory analyses reports and, if DU is suspected, the weight-percentage of U-235 present in the samples.

Step 2: Identify the Goals of the Study:

Determine if detectable amounts of DU from M101 spotting rounds are migrating out from RCAs and impacting human health and the environment?

The term, "detectable amounts" is related to the term "minimum detectable concentrations" (MDCs, as defined in *MARSSIM*). The License RSO has identified a radiochemistry laboratory with MDLs and RLs shown on Worksheets #15b and #15c for surface water and sediment, respectively, to determine if the project action levels listed on Worksheet #15a have been exceeded.

If radiochemical laboratory analyses results from the primary analytical method (alpha spectrometry) indicate and secondary analytical method (ICP-MS) confirm that detectable amounts of DU from M101 spotting rounds is migrating out of an RCA, the Army will:

- Report results to NRC
- Perform confirmatory sampling and analyses for that RCA
- Obey any subsequent NRC orders
- Continue implementation of the ERMP for that RCA until NRC ends the requirement.

Step 3: Identify Information Inputs:

The information that is required to resolve the decision statement, establish release criteria, and confirm the appropriate analytical methods in order to provide adequate data to make the decisions are identified below.

Information Required to Resolve the Decision Statement:

Environmental variables or other information are needed to resolve the decision statement. Per the PAERMP, this includes:

- Presence of detectable amounts of DU in surface water flowing from the RCA
- Presence of detectable amounts of DU in groundwater potentially affected by DU in the RCA
- Presence of detectable amounts of DU in soil eroded from the RCA
- Presence of detectable amounts of DU in sediment that surface water flowing from the RCA carried from the RCA.

Identify and list the sources for the required information. Per the PAERMP (U.S. Army 2020):

- If surface water routinely flows from the RCA, then sampling of this surface water will occur. If flow occurs throughout the year, then sampling will occur during the quarters identified historically with the highest and lowest flows. If flow is intermittent, then sampling will occur during that flow with an attempt to capture the quarters identified historically with the highest and lowest flows.
- The U.S. Army will make available for NRC review upon request the results of all U.S. Army measurements of uranium concentration in groundwater samples that were collected with the purpose of meeting SDWA requirements.
- If existing wells potentially influenced by DU in the RCA are available, then whenever anyone samples these wells for any purpose, he or she will also require analyses for isotopes of uranium and report the results to the installation RSO. Otherwise, no conditions require groundwater sampling.
- Semiannual soil sampling is required if erosion conditions occur as described in the PAERMP.
- Sediment sampling will occur at the same time and near the same place. If surface water is not present, sediment sample(s) will be collected as planned (per site-specific annexes).

Information Required to Establish Action Levels:

NRC has provided the action level in license condition #17 ("analytical sampling results from locations outside of the RCA indicate that the U-238/U-234 activity ratio exceeds 3").

Information Required to Confirm that Appropriate Measurement Methods Exist to Provide the Necessary Data:

Appropriate measurement methods exist to provide the necessary data.

- Surface water sampling (only for water flowing out of the RCA)
- Groundwater sampling (none performed for license purposes; sampling for other purposes will include uranium as an analyte)
- Soil sampling (only for eroded soil as described in the PAERMP)
- Sediment sampling (only at same locations as surface water sampling, if any)
- Radiochemistry and chemistry analyses.

Laboratory analytical methods have been chosen for sample analysis to provide detection limits for isotopic and total uranium that are sufficiently low for ERM.

The U.S. Army has selected the use of alpha spectrometry (e.g., DOE HASL method 300) to measure total and isotopic uranium (U-234, U-235, and U-238) activities with an overall project isotopic MDC goal of 0.1 pCi/L for water samples and 0.1 pCi/g for soil/sediment samples. For samples with U-238/U-234 ratios exceeding 3.0, the U.S. Army will re-analyze samples using ICP-MS (e.g., Solid Waste Method 6020A) with reporting limit goals of 0.05 µg/L for water and 5 µg/kg for soil/sediment samples. Analysis by ICP-MS for U-234, U-235, and U-238 mass concentrations will identify samples with DU content (NRC 2016).

Step 4: Define the Boundaries of the Study:

Specify characteristics that define the true but unknown value of the parameter of interest: NRC has provided the parameter of interest in license condition #17 ("analytical sampling results from locations outside of the RCA indicate that the U-238/U-234 activity ratio exceeds 3"). The chemical boundaries for surface water and sediment sampling during the ERM are limited to total/isotopic uranium activities and concentrations based on analysis results from alpha spectrometric and ICP-MS methods (e.g., HASL 300 or equivalent and SW846 6020A).

Define the geographic area within which all decisions must apply: See Site-Specific ERMP Annexes developed for each "M101 Impact Area," which NRC has incorporated into the license by reference. They show the specific locations and the surrounding area of each RCA. Each RCA defines the local area for ERM purposes based on the 1,000m x 1,000m target zones/impact areas delineated for historical training with M101 spotting rounds.

Determine the timeframe to which the decision applies: The timeframe is the duration of the license. Additional temporal considerations for the ERM include the estimated time it may require DU to reach groundwater, the time it may take a potential DU groundwater plume to reach a surface water body, the seasonal fluctuations of groundwater levels, migration directions, the seasonal effects of surface water runoff, and flood events. Practical constraints, such as the seasonal variability in the presence or absence of surface water, physical boundaries and requirements in the U.S. Army's license, also are considered.

Determine when to collect data: See STEP 3.

Define the scale of decision making: The PAERMP and the environmental setting provide guidance for sampling strategies included in the Site-Specific ERMP Annexes. These strategies are based on the collection of media that could be impacted by DU from M101 spotting rounds from historical training operations and transported outside RCAs to impact human health and the environment. The Site-Specific ERMP Annexes do not address other potential hazards that may be present within and outside RCAs such as explosive safety hazards and potential risks associated with other munitions constituents.

Identify practical constraints on data collection: Possible constraints include inaccessible areas due to:

- Bad weather (safety) – Wait for improved conditions
- Ongoing training (land use) – Wait for completion of training
- Rough terrain (safety) – Apply risk management principles (DA PAM 385-30)
- UXO (safety) – No sampling.

Additional constraints or obstacles that may interfere with full implementation of data collection include seasonal conditions when sampling is not possible (e.g., flooding, lack of surface water) or during controlled burns when accessing the site is dangerous. Sampling surface water and sediment is more practical and safer during low-flow events in late summer and fall. However, limiting surface water and sediment sampling to low-flow seasons has drawbacks related to potential runoff during storm events. Actual temporal and physical constraints to sampling are discussed in the Site-Specific ERMP Annexes.

Step 5: Develop the Analytic Approach:

The PAERMP provides decision rules about whether, where, and when environmental samples will be collected. License condition #17 provides information to develop the decision rule about whether a sample reliably contains DU.

The following action levels are based on criteria specified in the PAERMP and NRC regulations (10 CFR § 110.2 for Definitions):

- 150 pCi/L or more for surface water
- U-238/U-234 ratio of 3.0 or greater.

The surface water decision rules for ERM are provided below. Principal decision makers regarding these rules and potential further action are the U.S. Army and the regulatory agencies:

- IF detections are below the action level (150 pCi/L) within the surface water samples, THEN no action is necessary.
- IF detections are greater than the action level (150 pCi/L) within one or more surface water samples, THEN the U.S. Army will notify NRC within 30 days, after which the U.S. Army will await further instructions, if any, from NRC.

The decision rules for assessing the presence of DU in any environmental media sampled during the Site-Specific ERMP Annexes are provided below. Principal decisions regarding these rules and potential further action are the Army and the regulatory agencies:

- IF the U-238/U-234 ratio by alpha spectrometry plus the value of total propagated uncertainty (TPU) is less than 3.0 for any sampled media, THEN no action is necessary.
- IF the U-238/U-234 ratio by alpha spectrometry plus the value of TPU is greater than 3.0 for any sampled media, THEN the sample will be analyzed by ICP-MS.
- IF the ICP-MS results for U-235 and total uranium exceed their method detection limits (MDLs), THEN the U-235 weight percentage can be calculated by dividing the mass of U-235 by the total uranium mass and multiplying by 100.
- IF the weight percent of U-235 exceeds 0.711, THEN the sample result is suggestive of natural uranium, otherwise the sample result is suggestive of DU. By regulation, DU is source material uranium in which uranium-235 is less than 0.711 percent by weight of the total uranium present. See 10 C.F.R. § 40.4.
- IF the ICP-MS results for U-235 are non-detect, THEN the total uranium result will be compared against a lower comparison value (LCV).
- The LCV is determined using the following steps:
    - Using previously collected data from the environmental sample location in question, calculate the mean of all U-238/U-234 ratios that have detectable U-234 and U-238.
    - The total uranium concentration of all samples that have U-238/U-234 ratios within two standard deviations of the mean will be included in the background data set for determining the total uranium LCV.
    - Determine the weighted mean ($\bar{x}$) total uranium value for all samples included in the data set and the associated propagated uncertainty ($\sigma_{\bar{x}}$).
    - Calculate the weighted mean and uncertainty using the following equations:

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \qquad w_i = \frac{1}{\sigma_i^2}$$

$$\sigma_{\bar{x}} = \sqrt{\frac{1}{\sum_{i=1}^{n} \sigma_i^{-2}}} = \sqrt{\frac{1}{\sum_{i=1}^{n} w_i}},$$

    - Add the propagated uncertainty to the weighted mean value to obtain the LCV in pCi/g for sediment or pCi/L for surface water.
    - Convert the LCV for sediment using the following equation:

$$\frac{Total\ U\ mean\left(\frac{pCi}{g}\right) * 1E3(\frac{g}{kg})}{\frac{677{,}000\left(\frac{pCi}{g} specific\ activity\ for\ U-nat\right)}{\frac{1E3(mg)}{g}}}$$

- Convert the LCV for surface water using the following equation:

$$\frac{Total\ U\ mean\left(\frac{pCi}{L}\right) * 1E6(\frac{ug}{g})}{677{,}000(\frac{pCi}{g} specific\ activity\ for\ U-nat)}$$

- IF the result is below the LCV, THEN the sample result is suggestive of natural uranium, otherwise an additional environmental sample will be collected and analyzed.

Step 6: Specify Performance or Acceptance Criteria:

Decisions with respect to the DU activity concentration (for samples analyzed by alpha spectrometry) or mass concentration (for samples analyzed by ICP-MS) must fully consider each source of uncertainty such that the result includes the total propagated uncertainty. Decision errors can occur at various stages during the sample collection and analysis. This uncertainty includes a variety of factors such as the variability inherent in radioactive decay; uncertainty introduced in determining the sample volume or mass; detector/instrument background; detector calibration; and sample characteristics, such as solubility and homogeneity.

Worksheet #12 provides the performance criteria to be used for acceptance of analytical data as well as the sensitivity of the analytical methods/instrumentation used to perform the chemistry analyses as presented on **Worksheet #15**. The usability of the analytical data will be based on adherence of the analysis of the QC requirements summarized on **Worksheet #28** and on overall precision, accuracy, representativeness, comparability, and completeness as described on **Worksheet #37.**

Step 7: Describe the Plan for Obtaining Data:

The Site-Specific ERMP Annexes present the sampling plan and field tasks for each site. In general, the collection of surface water and sediment samples are proposed as detailed in these plans to collect the necessary data to satisfy the decision statement for the ERMP:

The analytical samples will be supplemented by the appropriate number of QC samples (e.g., field duplicate, MS/MSD) as described on **Worksheet #28**. All samples will be containerized, labeled, and tracked in accordance with the established SOPs listed on **Worksheet #21**. **Worksheet #14/16** provides the proposed schedule of activities for the Site-Specific ERMP Annexes. **Worksheet #17** presents the sampling design, rationale, and figures for the Site-Specific ERMP Annexes.

CFR = Code of Federal Regulations
DA = Department of the Army
DOE = U.S. Department of Energy
DQO = Data Quality Objective
DU = Depleted Uranium
ERM = Environmental Radiation Monitoring
ERMP = Environmental Radiation Monitoring Plan
GC = Garrison Commander
HASL = Health and Safety Laboratory
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
M^2 = Square Meters
MARSSIM = Multi-Agency Radiation Survey and Site Investigation
MDC = Minimum Detectable Concentration
MDL = Method Detection Limit
MS = Matrix Spike
MSD = Matrix Spike Duplicate
NRC = Nuclear Regulatory Commission
PAERMP = Programmatic Approach for Preparation of Site-Specific ERMPs
PAM = Pamphlet
pCi/g = Picocuries per Gram
pCi/L = Picocuries per Liter
QAPP = Quality Assurance Project Plan
QC = Quality Control
RCA = Radiation Control Area
RL = Reporting Limit
RSO = Radiation Safety Officer
SDWA = Safe Drinking Water Act
SOP = Standard Operating Procedure
U-234 = Uranium-234
U-235 = Uranium-235
U-238 = Uranium-238
USEPA = U.S. Environmental Protection Agency
UXO = Unexploded Ordnance
µg/kg = Micrograms per Kilogram
µg/L = Micrograms per Liter

QAPP Worksheet #12. Measurement Performance Criteria

Matrix: Surface Water
Analytical Group or Method: TBD for alpha spectrometry (examples below based on HASL 300 or equivalent)
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field duplicate	RER ≤3.0 when uranium is detected in both samples ≥ sample-specific RL
Analytical Precision Laboratory – LCSD/MSD Laboratory Effects	LCSD/MSD Laboratory duplicate	RER ≤3.0 RER ≤3.0
Analytical Accuracy/Bias Laboratory – LCS/MS	LCS/MS	U-233/U-234 75-125% U-238 75-125%
Laboratory Accuracy/Bias (Contamination)	Method blank	No target analyte concentrations ≥1/2 RL
Analytical Accuracy/Bias Laboratory and Matrix Effects	Tracer	U-232 30-110%
Completeness	Number of valid data points attained versus the planned number	90%

DQI = Data Quality Indictor
HASL = Health and Safety Laboratory
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
RER = Relative Error Ratio
RL = Reporting Limit
TBD = To Be Determined
U-232 = Uranium-232
U-233 = Uranium-233
U-234 = Uranium-234
U-248 = Uranium-238

QAPP Worksheet #12. Measurement Performance Criteria (Continued)

Matrix: Sediment
Analytical Group or Method: TBD for alpha spectrometry (examples below based on HASL 300 or equivalent)
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field duplicates	RER ≤3.0 when uranium is detected in both samples ≥ sample-specific RL
Analytical Precision Laboratory – LCSD/MSD Laboratory Effects	LCSD/MSD Laboratory duplicate	RER ≤3.0 RER ≤3.0
Analytical Accuracy/Bias Laboratory – LCS/MS	LCS/MS	U-233/U-234 75-125% U-238 75-125%
Laboratory Accuracy/Bias (Contamination)	Method blank	No target analyte concentrations ≥1/2 RL
Analytical Accuracy/Bias Laboratory and Matrix Effects	Tracer	U-232 30-110%
Completeness	Number of valid data points attained versus the planned number	90%

DQI = Data Quality Indicator
HASL = Health and Safety Laboratory
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
RER = Relative Error Ratio
RL = Reporting Limit
TBD = To Be Determined
U-232 = Uranium-232
U-233 = Uranium-233
U-234 = Uranium-234
U-238 = Uranium-238

QAPP Worksheet #12. Measurement Performance Criteria (Continued)

Matrix: Surface Water
Analytical Group or Method: TBD for ICP-MS (examples below based on 6020A)
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field duplicate	RPD ≤30% when uranium is detected in both samples ≥ sample-specific LOQ
Analytical Precision Laboratory – LCSD Laboratory and Matrix Effects – MSD	LCSD/MSD Laboratory duplicate	RPD ≤20% RPD ≤20%
Analytical Accuracy/Bias Laboratory – LCS Laboratory and Matrix Effects – MS	LCS/MS*	U-238 LCS 80-120% MS 75-120%
Laboratory Accuracy/Bias (Contamination)	Method blank	No target analyte concentrations ≥1/2 LOQ
Overall Accuracy/Bias (Contamination)	Field equipment rinsate blanks and field QC blanks (source tap and source DI water)	N/A
Completeness	Number of valid data points attained versus the planned number	90%

*Data will be evaluated to the QSM limits (87-120%), but corrective action will only be pursued if the yields fall outside our standard laboratory criteria (shown above). Any yields that fall outside of the QSM criteria will be narrated.

DI = Deionized
DQI = Data Quality Indicator
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
LCS = Laboratory Control Sample
LCSD = Laboratory control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
N/A = Not Applicable
QC = Quality Control
QSM = Quality System Manual
RPD = Relative Percent Difference
TBD = To Be Determined
U-238 = Uranium-238

QAPP Worksheet #12. Measurement Performance Criteria (Continued)

Matrix: Sediment
Analytical Group or Method: TBD for ICP-MS (examples below based on 6020A)
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Overall Precision	Field duplicate	RPD≤ 40% when uranium is detected in both samples ≥ sample-specific LOQ
Analytical Precision Laboratory – LCSD Laboratory and Matrix Effects – MSD	LCSD/MSD Laboratory duplicate	RPD≤ 20% RPD≤ 20%
Analytical Accuracy/Bias Laboratory – LCS Laboratory and Matrix Effects – MS	LCS/MS*	U-238 LCS 80-120% MS 75-125%
Laboratory Accuracy/Bias (Contamination)	Method blank	No target analyte concentrations ≥1/2 LOQ
Overall Accuracy/Bias (Contamination)	Field equipment rinsate blanks and field QC blanks (source tap and source DI water)	N/A
Completeness	Number of valid data points attained versus the planned number	90%

*Data will be evaluated to the QSM limits (83-120%) but corrective action will only be pursued if the yields fall outside our standard lab criteria (shown above). Any yields that fall outside of the QSM criteria will be narrated.

DI = Deionized
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
DQI = Data Quality Indicator
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
N/A = Not Applicable
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
TBD = To Be Determined
U-238 = Uranium-238

QAPP Worksheet #13. Secondary Data Uses and Limitations

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Previous Sampling Results	Various reports listed on QAPP Worksheets #1 and #2.	Information related to the historical sampling locations and field procedures used historically.	There are no factors affecting the reliability of the previous sampling results.

QAPP = Quality Assurance Project Plan

QAPP Worksheets #14 and #16. Project Tasks and Schedule

Activities	Responsible Organization	Deliverable	Planned Start Date	Deliverable Due Date
Develop "Programmatic and Site-Specific ERMP for Nationwide DU Sites" and submit to NRC	U.S. Army (IMCOM)	Final ERMP	7 June 2016	21 September 2016
Develop site-specific dose modeling parameters, conduct modeling, and report results for RCAs at 18 licensed locations to NRC	U.S. Army (IMCOM)	Final ERMP	7 June 2016	21 September 2016
Conduct field sampling at RCAs at 18 licensed locations	U.S. Army (IMCOM)	Final Report	TBD*	TBD*
Develop and submit Final Reports for RCAs at 18 licensed locations to NRC	U.S. Army (IMCOM)	Final Report	TBD*	TBD*

DU = Depleted Uranium
ERMP = Environmental Radiation Monitoring Plan
IMCOM = Installation Management Command
NRC = Nuclear Regulatory Commission
RCA = Radiation Control Area
TBD = To Be Determined

QAPP Worksheet #15a. Project Action Levels for the ERM Media

Medium	Total Uranium Action Level	Corrective Action
Surface Water	≥ 150 pCi/L	When analytical sampling results indicate that the total concentration of uranium exceeds 5.5 Bq/L (150 pCi/L), the U.S. Army will notify NRC within 30 days after which the Army will await further instructions, if any, from NRC.
	Less than 150 pCi/L	No corrective action.
All	U-238/U-234 ratio ≥ 3.0	Reanalyze the samples using ICP-MS (SW 846 6020A), track trend at location.
	Less than 3.0	No corrective action.

Bq/L = Becquerel per Liter
ERM = Environmental Radiation Monitoring
ERMP = Environmental Radiation Monitoring Plan
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
NRC = Nuclear Regulatory Commission
pCi/L = Picocuries per Liter
RCA = Range Control Area
RSO = Radiation Safety Officer
U-234 = Uranium-234
U-238 = Uranium-238
µg/L = Micrograms per Liter

QAPP Worksheet #15b. Laboratory-Specific Detection/Quantitation Limits for Surface Water

Analyte	CAS Number	RL	MDL
TBD (examples below based on HASL 300 or equivalent) (pCi/L)			
U-233/U-234	11-08-5	0.10	N/A
U-235/U-236	15117-96-1	0.10	N/A
U-238	7440-61-1	0.10	N/A
Total Uranium	7440-61-1	N/A	N/A
TBD (examples below based on SW846 6020A) (µg/L)*			
U-233/U-234	11-08-5	0.05	0.0003
U-235/U-236	15117-96-1	0.05	0.0003
U-238	7440-61-1	0.05	0.0003
Total Uranium	7440-61-1	0.05	0.0003

*Samples with U-238/U-234 ratios exceeding 3.0 will be re-analyzed using Solid Waste Method 6020A with water or sediment remaining from the aliquot collected for the alpha spectrometry analysis.

CAS = Chemical Abstract System
HASL = Health and Safety Laboratory
MDL = Method Detection Limit
N/A = Not Applicable
RL = Reporting Limit
pCi/L = Picocuries per Liter
TBD = To Be Determined
U-233 = Uranium-233
U-234 = Uranium-234
U-235 = Uranium-235
U-236 = Uranium-236
U-238 = Uranium-238
µg/L = Micrograms per Liter

QAPP Worksheet #15c. Laboratory-Specific Detection/Quantitation Limits for Sediment

Analyte	CAS Number	RL	MDL
TBD (examples below based on HASL 300 or equivalent) (pCi/g)			
U-233/U-234	11-08-5	0.10	N/A
U-235/U-236	15117-96-1	0.10	N/A
U-238	7440-61-1	0.10	N/A
Total Uranium	7440-61-1	N/A	N/A
TBD (examples below based on SW846 6020A) (µg/kg)*			
U-233/U-234	11-08-5	5	1
U-235/U-236	15117-96-1	5	1
U-238	7440-61-1	5	0.1
Total Uranium	7440-61-1	5	0.1

*Samples with U-238/U-234 ratios exceeding 3.0 will be re-analyzed using Solid Waste Method 6020A with water or sediment remaining from the aliquot collected for the alpha spectrometry analysis.

CAS = Chemical Abstract System
HASL = Health and Safety Laboratory
MDL = Method Detection Limit
N/A = Not Applicable
pCi/g = Picocuries per Gram
RL = Reporting Limit
TBD = To Be Determined
U-233 = Uranium-233
U-234 = Uranium-234
U-235 = Uranium-235
U-236 = Uranium-236
U-238 = Uranium-238
µg/kg = Micrograms per Kilogram

QAPP Worksheet #17. Sampling Design and Rationale

ERM Sampling of Sediment and Surface Water Samples (see Worksheet #18 for sample IDs)

Physical boundaries: See Site-Specific ERMP Annexes for the proposed sampling locations outside the RCA boundaries during the ERM at all sites.

Time period: Sampling to be conducted semiannually**.** Table 17-1 identifies the sampling selections for each installation in order to capture the high/low flow occurrences. These selections are based on review of the historical mean of monthly stream discharge rates at nearby or regional USGS stream gauges. In most cases, the evaluation included data from 2010 until the present time.

Table 17-1. Sampling Quarter Selections Based on Historical Mean of Monthly Discharge at Nearby or Regional USGS Stream Gauges

Installation	Historical High Flow	Historical Low Flow*	Additional Notes
Donnelly Training Area, Fort Wainwright, AK	3Q	2Q	Delta River often remains frozen during the first quarter.
Fort Benning, GA	1Q	4Q	
Fort Bragg, NC	1Q	3Q	
Fort Campbell, KY	1Q	3Q	
Fort Carson, CO	2Q	4Q	
Fort Gordon, GA	1Q	4Q	
Fort Hood, TX	2Q	3Q	
Fort Hunter Liggett, CA	1Q	late 2Q/ early 3Q	Surface water historically has been unavailable during the third quarter.
Fort Jackson, SC	1Q	4Q	
Fort Knox, KY	2Q	3Q	
Fort Polk, LA	1Q	4Q	
Fort Riley, KS	2Q	1Q	
Fort Sill, OK	2Q	4Q	
Joint Base Lewis-McChord, WA	1Q	3Q	
Yakima Training Center, WA	2Q	4Q	
Joint Base McGuire-Dix-Lakehurst, NJ	1Q	3Q	
Pohakuloa Training Area, HI	4Q	3Q	Per the ERMP, only sediment sampling is required. Surface water was not present during any of the ERM events.
Schofield Barracks, HI	1Q	3Q	Per the ERMP, only sediment sampling is required. Surface water was collected when present.

*The timing of the low-flow occurrence event will be adjusted annually based on observed availability of surface water.

1Q = First quarter
2Q = Second quarter
3Q = Third quarter
4Q = Fourth quarter

Description of sampling areas: The Site-Specific ERMP Annexes contain the specific design for each RCA. The PAERMP constrains decisions about the design for obtaining data. The ERMP was developed to provide direct surveillance of the most probable migration routes through periodic sampling and analysis of radioactive constituents.

Basis for number and placement of samples: The Site-Specific ERMP Annexes contain the details regarding the number and location of samples.

QAPP Worksheet #17. Sampling Design and Rationale (Continued)

Sampling methodology: Site-specific information affecting the collection of surface water and sediment samples can be found in the Site-Specific ERMP Annexes. All surface water and sediment sampling for the ERM will follow the SOPs listed on **Worksheet #21**. All surface water and sediment samples will be analyzed for total and isotopic uranium by an analytical laboratory. Upon receipt at the analytical laboratory, the samples will be preserved in the original sample container. In addition, the samples will not be filtered in the field or by the analytical laboratory prior to preservation and processing.

How sample positions will be located and determined in the field: The locations of the surface water and sediment are presented in the Site-Specific ERMP Annexes. The sample locations will be located in the field using site maps generated by the project GIS analyst. In addition, these locations will be preloaded into a handheld DGPS, which will then be used by field personnel to locate the sample locations.

Plan for changed location: The proposed ERM sampling locations are pre-established and, where possible, have been historically sampled during previous sampling activities. If insufficient surface water is observed at the predetermined locations, the potential need for relocation of any sampling while in the field will be determined by consultation between the Project Manager and License RSO (or designee).

Contingencies for field condition effects: The ERM sampling approach at each site is pre-established and will be implemented by following the field SOPs with minimal impact from field conditions. Any required changes will be approved through completion of Field Change Orders.

DGPS = Differential Global Positioning System
ERM = Environmental Radiation Monitoring
ERMP = Environmental Radiation Monitoring Plan
GIS = Geographic Information System
ID = Identifier
PAERMP = Programmatic Approach for Preparation of Site-Specific Environmental Radiation Monitoring Plans
RCA = Radiation Control Area
RSO = Radiation Safety Officer
SOP = Standard Operating Procedure
USGS = U.S. Geological Survey

QAPP Worksheet #18. Sampling Locations and Methods

Refer to the Site-Specific ERMP Annexes for details on the sampling locations for each installation. Field sampling methods and SOPs can be found on Worksheet #21 of this Programmatic UFP-QAPP.

ERMP = Environmental Radiation Monitoring Plan
QAPP = Quality Assurance Project Plan
SOP = Standard Operating Procedure
UFP = Uniform Federal Policy

QAPP Worksheets #19 and #30. Sample Containers, Preservation, and Hold Times

Laboratory/Contact Information

Laboratory Name:	TBD
Laboratory Address:	TBD
City, State:	TBD
POC:	TBD
Email and Phone Number:	DoD ELAP Accredited
Accreditations/Certificates:	TBD
Expiration:	
Sample Delivery Method:	

Matrix	Analytical Group	USEPA Preparation and Analytical Method	Laboratory Analytical and Preparation Method/SOP	Organization Performing Analysis	Sample Container Quantity and Type	Sample Preservation[b]	Data Package Turnaround Time	Sample Holding Time
Groundwater/ Surface Water	Isotopic Uranium[a]	Alpha spectrometry (e.g., HASL 300[c])	Alpha spectrometry (e.g., HASL 300[c])	TBD	1, 1-L polypropylene bottle	None	30 days	6 months
Groundwater/ Surface Water	Isotopic Uranium	ICP-MS (e.g., SW846 6020A)	ICP-MS (e.g., SW846 6020A)	TBD	1, 1-L polypropylene bottle	None	30 days	6 months
Sediment	Isotopic Uranium [a]	Alpha spectrometry (e.g., HASL 300[c])	Alpha spectrometry (e.g., HASL 300[c])	TBD	1, 8-oz. glass jar, can, or plastic bag	None	30 days	6 months
Sediment	Isotopic Uranium	ICP-MS (e.g., SW846 6020A)	ICP-MS (e.g., SW846 6020A)	TBD	1, 8-oz. glass jar, can, or plastic bag	None	30 days	6 months

[a]Samples with U-238/U-234 ratios exceeding 3.0 will be re-analyzed using Solid Waste Method 6020A with water or sediment remaining from the aliquot collected for the alpha spectrometry.
[b]Upon receipt at the analytical laboratory, the samples will be preserved in the original sample container. In addition, the samples will not be filtered in the field or by the laboratory prior to preservation and processing.
[c]Method HASL 300 or equivalent

DoD = U.S. Department of Defense
ELAP = Environmental Laboratory Accreditation Program
HASL = Health and Safety Laboratory
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
POC = Point of Contact
SOP = Standard Operating Procedure
SW = Solid Waste
TBD = To Be Determined
U-234 = Uranium-234
U-238 = Uranium-238
USEPA = U.S. Environmental Protection Agency

QAPP Worksheet #20. Field Quality Control Summary

The following are maximum numbers of field and QC samples that may be collected under this QAPP; frequencies will be as indicated below for the QC samples at each site/installation.

Parameter	Analytical Method	Number of Field Samples (1)	Field Duplicate Samples (2)	MS/MSD Samples (3)	Total Analyses
Surface Water					
Total/Isotopic Uranium*	TBD*	48	5	2	55
Sediment					
Total/Isotopic Uranium*	TBD*	56	6	3	65

*Samples analyzed with alpha spectrometry with U-238/U-234 ratios exceeding 3.0 will be re-analyzed using ICP-MS for water or sediment; remaining sample from the aliquot collected for the alpha spectrometry analysis will be used for the ICP-MS analysis.

(1) Maximum expected number of samples is approximately 31 co-located surface water/sediment samples from all active ranges.
(2) Field duplicates will be collected at an overall frequency of 10% for each matrix.
(3) MS/MSD samples will be collected at an overall frequency of 5% for each matrix.

NOTE: Field QC samples are limited to field duplicates and samples collected to be used for MS/MSD; QA split samples are not proposed. Equipment rinsate samples are not required because sampling will be performed using disposable equipment.

ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QA = Quality Assurance
QC = Quality Control
QAPP = Quality Assurance Project Plan
TBD = To Be Determined
U-234 = Uranium-234
U-238 = Uranium-238

QAPP Worksheet #21. Field SOPs

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work?	Comments
TBD					
TBD					
TBD					
TBD					
TBD					
TBD					
TBD					
TBD					
TBD					
TBD					

SOP = Standard Operating Procedure
TBD = To Be Determined

QAPP Worksheet #22. Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Schonstedt® Handheld Magnetometer or similar	N/A	Check battery	Pass unit over known metallic object	Inspect for visible damage	Inspect prior to each use	Proper tone produced	Replace battery and/or decontaminate	UXO Specialist	Operation Manual
DGPS	N/A	Check battery and cable connections	Start unit and check display for proper geographic positioning	Inspect for visible damage	Inspect prior to each use	N/A	Replace battery; reboot as required	Field Sampler	Operation Manual
Horiba U-22 Water Quality Meter or similar	Verify calibration with auto-calibration solution for pH, conductivity, and turbidity following manufacturer's instructions	Check battery	N/A	Inspect for visual damage	Calibrate at beginning of day	Calibration is within range	Recalibrate if necessary, replace batteries, or perform maintenance as required	Field Sampler	Operation Manual, SOP-8
Bicron Microrem Meter or similar	Calibrate with NIST traceable sources	Perform detailed QA/QC check at least daily and when instrument response is questionable	Compare instrument readins with those of a known radiation source	Inspect for visible damage	Inspect a minimum of daily and when instrument response is questionable; calibrate at least annually	Calibration is within range	Replace batteries, cables and mylar as needed; repair and recalibration by manufacturer as needed	Health Physics technican in Coordination with Calibration Technician	Manufacturers' Operation and Maintenance Manuals
Ludlum Model 44-9 GM/ Frisker or similar	Calibrate with NIST traceable sources	Perform detailed QA/QC check at least daily and when instrument response is questionable	Compare instrument readings with those of a known radiation source	Inspect for visible damage	Inspect a minimum of daily and when instrument response is questionable; calibrate at least annually	Calibration is within range	Replace batteries, cables, and mylar as needed; repair and recalibration by manufacturer as needed	Health Physics Technician in coordination with Calibration Technician	Manufacturers' Operation and Maintenance Manuals

QAPP Worksheet #22. Field Equipment Calibration, Maintenance, Testing, and Inspection (Continued)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Ludlum Model 43-89 Dual Phosphor Alpha/Beta Detector with Model 2360 Scaler/ Ratemeter or similar	Calibrate with NIST traceable sources	Perform detailed QA/QC check at least daily and when instrument response is questionable	Compare instrument readings with those of a known radiation source	Inspect for visible damage	Inspect a minimum of daily and when instrument response is questionable; calibrate at least annually	Calibration is within range	Replace batteries, cables, and mylar as needed; repair and recalibration by manufacturer as needed	Health Physics Technician in coordination with Calibration Technician	Manufacturers' Operation and Maintenance Manuals
Ludlum Model 44-10 Gamma Scintillation Detector with Model 2221 Scaler/ Ratemeter or similar	Calibrate with NIST traceable sources	Perform detailed QA/QC check at least daily and when instrument response is questionable	Compare instrument readings with those of a known radiation source	Inspect for visible damage	Inspect a minimum of daily and when instrument response is questionable; calibrate at least annually	Calibration is within range	Replace batteries, cables, and mylar as needed; repair and recalibration by manufacturer as needed	Health Physics Technician in coordination with Calibration Technician	Manufacturers' Operation and Maintenance Manuals

DGPS = Differential Global Positioning System
N/A = Not Applicable
NIST = National Institute of Standards and Technology
QA = Quality Assurance
QC = Quality Control
SOP = Standard Operating Procedure
UXO = Unexploded Ordnance

QAPP Worksheet #23. Analytical SOPs

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix	Analytical Group	Organization Performing Analysis	Modified for Project Work?
TBD						
TBD						
TBD						
TBD						
TBD						

SOP = Standard Operating Procedure
TBD = To Be Determined

QAPP Worksheet #24. Analytical Instrument Calibration

Instrument	Calibration Procedure*	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
Alpha Spectrometry (example information based on HASL 300 Method or equivalent)	Initial Calibration (ICAL)	Prior to initial use or following repair/loss of control	At least two calibration peaks that are 1) ≥700 keV apart; or 2) that bracket all peaks to be determined. Energy vs. channel slope equation <15 keV per channel. FWHM <100 keV for each peak used for calibration. Minimum of 3,000 net counts in each peak.	Correct problem; repeat	TBD	TBD
	Energy calibration (CHK)	Energy calibrations shall be performed for the systems monthly or when a calibration QC check indicates an unacceptable change in parameters	Three isotopes in 3-6 MeV range. Energy positions of isotopes within ± 40 KeV of expected value.	Correct problem; repeat calibration procedure; instrument maintenance; consult with technical director	TBD	TBD
	Efficiency calibration and background check (ICV)	Immediately after initial calibration	Three isotopes in 3-6 MeV range. Energy positions of isotopes within ± 20 KeV of expected value.	Correct problem; repeat calibration procedure; instrument maintenance; consult with technical director	TBD	TBD
	Subtraction spectrum (BKG)	Subtraction spectrum shall be performed for the systems monthly or when a calibration QC check indicates an unacceptable change in parameters	Within 3σ of mean activity of recent BSCs for total ROI.	Correct problem; repeat calibration procedure; instrument maintenance; consult with technical director	TBD	TBD
	Check (CCV) and background check (ICC)	Routine quality control verifications are performed weekly	Peak centroid, peak resolution, peak area, calibration and background must pass statistical test <3 sigma.	Correct problem; repeat procedure; instrument maintenance; consult with technical director	TBD	

QAPP Worksheet #24. Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure*	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
ICP-MS (example information based on Method 6020A)	ICAL – minimum 3-point calibration and a calibration blank	Daily initial calibration prior to sample analysis	Five standards and a blank; correlation coefficient of ≥ 0.995.			TBD
	Second source ICV	Once after each initial calibration, prior to sample analysis	Value of second source for all analyte(s) within ± 10% of expected.	Recalibrate	TBD	
	CCV	Every 10 samples	All analytes within +/- 10% of expected value.	Recalibrate	TBD	
	ICVL/CCVL	Immediately after ICV/CCV	+/- 30% expected value.	Recalibrate	TBD	
	IS	Every field sample, standard, and QC sample	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	Reanalyze failed samples at 5-fold dilutions until criteria is met. For failed QC, correct problem and rerun all associated failed field samples	TBD	

BKG = Background
BSC = Background Subtraction Count
CCV = Continuing Calibration Verification
CCVL = Low level CCV
CHK = Energy Calibration
FWHM = Full Width-Half Maximum
HASL = Health and Safety Laboratory
ICAL = Initial Calibration
ICC = Initial Calibration Check
ICP = Inductively Coupled Plasma
ICV = Initial Calibration Verification
ICVL = Low level ICV
IS = Internal Standard
KeV = Kiloelectron Volts
MeV = Megaelectron Volts
MS = Mass Spectrometry
QC = Quality Control
ROI = Region of Interest
SOP = Standard Operating Procedure
TBD = To Be Determined

QAPP Worksheet #25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Alpha Spectrometry (example information)	Clean chambers and planchette holders quarterly	Physical check	Physical check	Monthly	Acceptable background and calibration efficiencies	Recalibrate; instrument maintenance; consult with Technical Director	TBD	TBD
ICP-MS (example information)	ICB/CCB	Instrument performance	Instrument contamination check	ICB: After every calibration verification and ICV/ICVL pair CCB: every 10 samples after CCV/CCVL pair	ICB: No analytes detected > ½ RL; CCB: no analyte detected > 3X MDL No analytes detected > LOD	Determine possible source of contamination and apply appropriate measure to correct the problem; reanalyze calibration blank and all associated samples	TBD	TBD
	Daily performance check	Tune and stability check	Instrument stability and performance check	Daily	RSD ≤5% for all tune analytes Individual masses +/- 0.05 amu Peak Resolution 0.7 +/- amu at 10% peak height Abundance: Mg 7500 cps In 40000 cps U 30000 cps % Oxides (CeO/Ce) ≤ 4% Dual charge (Ba++/BA)≤3%	Troubleshooting; redo the tune/profile	TBD	

CCB = Continuing Calibration Blank
CCV = Continuing Calibration Verification
CCVL = Low level CCV
cps = Counts per Second
ICB = Initial Calibration Blank
ICP = Inductively Coupled Plasma
ICV = Initial Calibration Verification
ICVL = Low level ICV
LOD = Limit of Detection
MDL = Method Detection Limit
MS = Mass Spectrometry
RL = Reporting limit
RSD = Relative Standard Deviation
SOP = Standard Operating Procedure
SVOC = Semivolatile Organic Compound
TBD = To Be Determined

QAPP Worksheets #26 and #27. Sample Handling, Custody, and Disposal

Sampling organization: TBD
Laboratory: TBD
Method of sample delivery: Commercial carrier (TBD) with overnight delivery
Number of days from reporting until sample disposal: Until sample disposal is approved by U.S. Army

Activity	Organization and Title/Person Responsible	SOP Reference
Sample Labeling	Sample Manager	TBD
CoC Form Completion	Sample Manager	TBD
Packaging	Sample Manger/Field Manager/Field Crew	TBD
Shipping Coordination	Sample Manger/Field Manager/Field Crew	TBD
Sample Receipt, Inspection, and Login	Sample Receiving Staff	TBD
Sample Custody/Storage	Sample Receiving Staff	TBD
Sample Preparation	Technicians	TBD
Sample Determinative Analysis	Technicians	TBD
Sample Disposal	Sample Waste Disposal Staff	TBD

CoC = Chain-of-Custody
TBD = To Be Determined

QAPP Worksheet #28. Analytical Quality Control and Corrective Action

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Title/Position of Person Responsible for Corrective Action	Measurement Performance Criteria
Total/Isotopic Uranium (example information based on HASL 300 Method or equivalent)					
Field Duplicate	One per 10 samples	RER ≤3.0	No corrective action is taken on field duplicate data alone. Assess data and determine if re-sampling is required.	QA Officer	RER ≤3.0 when uranium is detected in both samples ≥ sample-specific RL
Method Blank	Each analytical batch	<RL for common laboratory contaminants; <½ RL for other contaminants	Re-analyze samples if possible; otherwise, report data and narrate.	TBD	< CRDL
LCS	One per analytical batch	See **Worksheet #12**	Re-prep and re-analyze samples if sufficient sample volume is available; otherwise, report data and narrate.	TBD	See **Worksheet #12**
LCSD or Laboratory Duplicate	One per analytical batch	See **Worksheet #12**	Re-prep and re-analyze samples if sufficient sample volume is available; otherwise, report data and narrate.	TBD	See **Worksheet #12**
Tracer	All samples	30-110% recovery	Reanalyze sample to confirm, Flag outliers.	TBD	Acceptable recoveries
Total/Isotopic Uranium (example information based on 6020A Method)					
Field Duplicate	One per 10 samples	RPD ≤30% for water; ≤40% for soil	No corrective action is taken on field duplicate data alone. Assess data and determine if re-sampling is required.	QA Officer	RPD ≤30% when uranium is detected in both samples ≥ sample-specific LOQ
Method Blank	Each analytical batch	<RL for common laboratory contaminants; <½ RL for other contaminants	Re-analyze samples if possible; otherwise report data and narrate.	TBD	<½ RL
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence	<RL for common laboratory contaminants; <½ RL for other contaminants	Re-analyze samples if possible; otherwise report data and narrate.	TBD	<½ RL

QAPP Worksheet #28. Analytical Quality Control and Corrective Action (Continued)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Title/Position of Person Responsible for Corrective Action	Measurement Performance Criteria
MS/MSD LCS/LCSD Laboratory Duplicate	Minimum of one type of QC duplicate per 20 samples	RPD <20%	Reprep and reanalyze sample and duplicate if sufficient sample material is available.	TBD	See **Worksheet #12**
MS LCS	One per analytical batch	See **Worksheet #12**	Re-analyze samples associated with the preparty batch if possible; otherwise, report data and narrate.	TBD	See **Worksheet #12**
Post Digestion Spike	When matrix spike fails	80-120%	Reanalyze post-digestion spike.	TBD	Acceptable recoveries
Serial Dilution	Each new sample matrix	1:5 dilution must agree within ±10% of original determination	Perform post-digestion spike addition if serial dilution does not meet criteria.	TBD	1:5 dilution must agree within ±10% of original determination.

CRDL = Contract Required Detection Limit
HASL = Health and Safety Laboratory
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QA = Quality Assurance
QC = Quality Control
RER = Relative Error Ratio
RL = Reporting Limit
RPD = Relative Percent Difference
SOP = Standard Operating Procedure
TBD = To Be Determined

QAPP Worksheet #29. Project Documents and Records

Record Type	Generation	Verification	Storage Location/Archival
Sample Logbook	Sample Manager	Field Manager	TBD
Identification of QC Samples	Sample Manager	QA Officer	TBD
CoC Records	Sample Manager	Field Manager	TBD
Sample Shipping Records	Sample Manager	Field Manager	TBD
Digital Photographs	Field Team Leader	Project Manager	TBD
Calibration (Field Equipment) Logs	Field Team Leader	Project Manager	TBD
Sample Receipt Forms	Laboratory Sample Manager	Project Manager	TBD
Sample Analytical Records (Full Level IV Data Package)	Laboratory Project or QA Manager	QA Officer	TBD
Equipment Calibration (Laboratory) and Maintenance Records	Laboratory Project or QA Manager	QA Officer	TBD
Source Documentation on Standards and Surrogates	Laboratory Project or QA Manager	QA Officer	TBD
QA/QC Records	Laboratory Project or QA Manager	QA Officer	TBD
Case Narrative	Laboratory Project or QA Manager	QA Officer	TBD
Corrective Action Reports	QA/QC Officer	Project Manager	TBD
EDD	Laboratory Project Manager	Data Validator	TBD
Equipment Inspection Forms	Sample Manager	Project Manager	TBD
Data Verification/Validation Assessment Report	Data Validator	QA/QC Officer	TBD
Nonconformance Report Forms	QA Officer	Project Manager	TBD
Readiness Review Checklist	QA Officer	Project Manager	TBD
Readiness Review Action Item Memorandum	QA Officer	Project Manager	TBD
Document Review Records	Independent Technical Reviewer	Project Manager	TBD

CoC = Chain-of-Custody
EDD = Electronic Data Deliverable
QA = Quality Assurance
QC = Quality Control
TBD = To Be Determined

QAPP Worksheets #31, #32, and #33. Assessments and Corrective Action

Assessments

Assessment Type	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
TBD					

Assessment Response and Corrective Action

Assessment Type	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Assessment Response Documentation	Timeframe for Response	Person(s) Responsible for Identifying and Implementing Corrective Actions (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Action (title and organizational affiliation)
TBD					

TBD = To Be Determined

QAPP Worksheet #34. Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications in the QAPP)
	Analytical Data Package		
1	Cover sheet (laboratory identifying information)	X	X
2	Case narrative and definition of qualifiers	X	X
3	Sample receipt records	X	X
4	Sample results (Form Is)	X	X
5	Blanks summaries	X	X
6	MS/MSD summaries	X	X
7	LCS summaries	X	X
8	Trace recoveries	X	X
10	Initial and continuing calibration summaries	X	X
11	Post digestion spike	X	X
12	Serial dilution	X	X
13	Analytical raw data for all data (i.e., calibrations, QC, and samples)	X	X
14	Required laboratory signatures	X	X
15	NCRs/CARs (if applicable)	X	X

CAR = Corrective Action Report
LCS = Laboratory Control Sample
MS = Matrix Spike
MSD = Matrix Spike Duplicate
NCR = Nonconformance Report
QAPP = Quality Assurance Project Plan
QC = Quality Control

QAPP Worksheet #35. Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field Logbook	QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples, including field QC samples, were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Project and Field Manager – Daily Project QA Officer
Sample Receipt and CoC	QAPP, Laboratory SOPs	The condition of shipping coolers and enclosed sample containers will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using a cooler receipt checklist. A Sample Receipt Confirmation Report will be transmitted to the Project Chemist within 48 hours of sample receipt. The original completed checklist will be transmitted with the final data package.	Documentation of sample receipt and generation of sample receipt checklist – Laboratory Project Manager Review of Sample Receipt Confirmation Report to ensure samples were logged in correctly – Project Chemist
Laboratory Data Package	QAPP, Laboratory SOPs	Verify data package for completeness, as defined in the QAPP, for the following: • Cover sheet with identifying information • Case narrative • Sample receipt information and CoC • Sample results • Blanks summaries • MS/MSD summaries • LCS summaries • Tracer recovery summaries • ISs • Initial and continuing calibration summaries • Analytical raw data • Required laboratory signatures.	Before release from laboratory – Laboratory Project Manager or QA Officer Upon receipt – Project Chemist
NCRs/CARs (if applicable)	QAPP	Verify that corrective action was implemented according to plan.	QA Officer

CAR = Corrective Action Report
CoC = Chain-of-Custody
IS = Internal Standard
LCS = Laboratory Control Sample
MS = Matrix Spike
MSD = Matrix Spike Duplicate
NCR = Nonconformance Report
QA = Quality Assurance
QAPP = Quality Assurance Project Plan
QC = Quality Control
SOP = Standard Operating Procedure

QAPP Worksheet #36. Data Validation Procedures

Data Validator	Project Chemist
Analytical Group/Method	Total/Isotopic Uranium – alpha spectrometric and ICP-MS methods
Data Deliverable Requirements	TBD
Analytical Specifications/Measurement Performance Criteria	Laboratory SOPs (TBD); QAPP **Worksheets #12, #15, #24**, and **#28**
Measurement Performance Criteria	**Worksheet #12**, DoD QSM
Percent of Data Packages to be Validated	100%
Percent of Raw Data Reviewed	10%
Percent of Results to be Re-Calculated	10%
Validation Procedure	Procedure based on current DoD QSM Version 5.1 and this QAPP

Note: Noncompliant data will be qualified as follows:

U = The analyte was analyzed for, but was not detected above, the reported sample quantitation limit. These results are qualitatively acceptable.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. These results are qualitatively acceptable but estimates.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. These results are qualitatively acceptable but estimates.
R = The analyte result was rejected due to serious deficiencies in the ability to analyze the sample and/or to meet QC criteria. The presence or absence of the analyte cannot be verified.

DoD = U.S. Department of Defense
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
QAPP = Quality Assurance Project Plan
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure
TBD = To Be Determined

QAPP Worksheet #37. Usability Assessment

Project Manager: TBD
Project QA Officer: TBD
Project Chemist: TBD
Field Task Leader: TBD
Field Sample Manager: TBD
Statistician: TBD

Review the Projects Objectives and Sampling Design:

The data usability assessment will be performed by a team of project personnel. The QA Officer will be responsible for information in the data usability assessment. Note that the data usability assessment will be conducted on verified/validated data. All data that were not rejected during the verification and validation process will be used for decision making. After the data usability assessment has been performed, data deemed appropriate for use then will be used to support further recommendations. The results of the data usability assessment will be presented in the final DQA.

Data Verification/Validation Outputs:

Precision—Results of all laboratory duplicates, MS/MSD pairs, LCS/LCSD pairs, and field duplicates will be assessed against measurement performance criteria provided on **Worksheet #12**. The RPDs exceeding criteria will be identified in the DQA. A discussion will follow summarizing the results of the laboratory precision. Any conclusions about the precision of the analyses will be drawn, and any limitations on the use of the data will be described.

Accuracy/Bias Contamination—Results for all laboratory method and instrument blanks and field QC blanks will be assessed against measurement performance criteria provided on **Worksheet #12**. Results for analytes that exceed criteria will be identified in the DQA. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn, and any limitations on the use of the data will be described in the DQA.

Overall Accuracy/Bias—The results for the LCS/LCSDs, MS/MSDs, ISs, and tracer recovery will be assessed against measurement performance criteria provided on **Worksheet #12**. In addition, initial and continuing calibration data will be compared to the requirements provided on **Worksheet #24**. A discussion will follow summarizing overall accuracy/bias. Any conclusions about the overall accuracy/bias of the analyses will be drawn, and any limitations on the use of the data will be described in the DQA.

Sensitivity—Results for all samples will be presented separately in tabular format for each analysis. The results for each analyte will be checked against the laboratory MDLs and reporting limits, and project action levels. A discussion will follow summarizing the results of the laboratory sensitivity. Any conclusions about the sensitivity of the analyses will be drawn, and any limitations on the use of the data will be described in the DQA.

Representativeness—Representativeness will be achieved by using standard sampling and analytical methodologies governing sample collection methods, sample size, preservation and handling, and methodology. Representativeness will be assessed qualitatively by ensuring that sample collection, handling, and analysis methodologies were followed. A discussion will follow summarizing the results of the representativeness of the results. Any conclusions about the representativeness of the analyses will be drawn, and any limitations on the use of the data will be discussed in the DQA.

Comparability—Comparability will be achieved by using standard sampling and analysis procedures that can be reproduced in future sampling events. Analytical results also will be compared semi-qualitatively to historical data available for the site and field observations. A discussion will follow summarizing the results of the comparability of the results. Any conclusions about the comparability of the analyses will be drawn, and any limitations on the use of the data will be described in the DQA.

Completeness—A completeness check will be done on all of the data generated by the laboratory. Completeness criteria are presented on **Worksheet #12** Completeness will be calculated as the number of valid data points (i.e., those that are not rejected in the data verification and validation process) divided by the total number of data points planned. Any conclusions about the completeness of the data for each analyte will be drawn, and any limitations on the use of the data will be described in the DQA.

QAPP Worksheet #37. Usability Assessment (Continued)

Reconciliation—Each of the project quality objectives presented on **Worksheet #11** will be examined to determine if the objective was met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the data validation, data quality indicators, and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the project quality objective was met and whether project action limits were exceeded. The final report will include a summary of all the points that went into the reconciliation of each objective. As part of the reconciliation of each objective, conclusions will be drawn, and any limitations on the usability of any of the data will be described.
Verify the Assumptions of the Selected Statistical Method: N/A
Implement the Statistical Method: N/A
Document Data Usability and Draw Conclusions: An analytical DQA report will be generated and will discuss limitations of data usability. This will include the evaluation of significant trends and biases in the QC results along with all components included in the data verification/validation report such as precision, accuracy, sensitivity, representativeness, comparability, and completeness. In general, data qualified as estimated due to the verification and validation process will be used for decision making. Rejected data will not be used. Potential trends and biases and nonconformances (such as outlier calibrations, spikes or elevated DL, LOD, and LOQ values) will be evaluated to determine if there are any limitations on data usability and discussed in the DQA.

DL = Detection Limit
DQA = Data Quality Assessment
IS = Internal Standard
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method Detection Limit
MS = Matrix Spike
MSD = Matrix Spike Duplicate
N/A = Not Applicable
QA = Quality Assurance
QC = Quality Control
RPD = Relative Percent Difference
TBD = To Be Determined

REFERENCES

Cabrera (Cabrera Services, Inc.). 2013. Vegetation Sampling Plan for Depleted Uranium, Schofield Barracks, Oahu, Hawaii. US Army Corps Of Engineers, US Army – Engineering and Support Center, Huntsville, AL 35816-1822. June

DoD (U.S. Department of Defense). 2021. Quality Systems Manual for Environmental Laboratories. Prepared by the Department of Defense Environmental Data Quality Workgroup. Version 5.4. Final. October.

IDQTF (Intergovernmental Data Quality Task Force). 2012. Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Manual, Optimized UFP-QAPP Worksheets. March.

NRC (U.S. Nuclear Regulatory Commission). 2021. NUREG-1757, Volume 2, Revision 2: Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria. Washington, DC: Nuclear Regulatory Commission.

U.S. Army. 2011. Davy Crockett M101 Spotting Round, Information Guide. U.S. Army Public Affairs Office. August.

U.S. Army. 2020. Programmatic Approach for the Preparation of Site-Specific Environmental Radiation Monitoring Plan.

USACE (U.S. Army Corps of Engineers). 2007. DoD Quality Systems Manual Supplement. USACE Louisville District. March.

USEPA (U.S. Environmental Protection Agency). 2006. Depleted Uranium Technical Brief. EPA-402-R-06-011. U.S. Environmental Protection Agency. Office of Air and Radiation, Radiation Protection Division, Washington, DC 20460. December.

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