Final

Uniform Federal Policy-Quality Assurance Project Plan for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump Ravenna Army Ammunition Plant Restoration Program

Camp James A. Garfield Joint Military Training Center
Portage and Trumbull Counties, Ohio

Contract No. W912QR-21-D-0016
Deliverable Order No. W912QR23F0014

Prepared for:

U.S. Army Corps of Engineers
Louisville District

Prepared by:

Leidos
8866 Commons Boulevard, Suite 201
Twinsburg, Ohio 44087

March 27, 2025

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Final

Uniform Federal Policy-Quality Assurance Project Plan for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump

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None.

14. ABSTRACT
The UFP QAPP provides a plan to investigation and define the extent of ACM and asbestos-contaminated soil in and around Debris Pile C at CC-RVAAP-78. This consists of six inter-related tasks: 1) prepare a UFP QAPP, 2) conduct trenching to refine the extent of friable ACM in Debris Pile C, 3) conduct soil sampling to refine the extent of asbestos-contaminated soil in Debris Pile C, 4) conduct data validation and laboratory oversight activities, 5) evaluate findings and data from the field effort and applicable historical information to produce a Remedial Investigation (RI) Report for the Quarry Pond Surface Dump, and 6) complete a Feasibility Study (FS) for friable ACM and asbestos-contaminated soil in Debris Pile C.

15. SUBJECT TERMS
asbestos, asbestos-containing material, remedial investigation, feasibility study, CERCLA, environmental sampling

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Documentation of Ohio EPA Concurrence of Final Document

(Documentation to be provided once concurrence is issued.)

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Company Name: Leidos

Contract and Delivery Order Number: Contract No. W912QR-21-D-0016, Delivery Order No. W912QR23F0014

Document Name: Uniform Federal Policy-Quality Assurance Project Plan for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield Joint Military Training Center, Portage and Trumbull Counties, Ohio

Notice is hereby given that an independent technical review, that is appropriate to the level of risk and complexity inherent in the project, has been conducted. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level obtained; and reasonableness of the result, including whether the product meets the customer's needs consistent with law and existing Corps policy. All concerns and comments resulting from these independent technical reviews have been resolved.

Mike Barta Study/Design Team Leader	3/27/2025 Date

Jed Thomas Independent Technical Review Team Leader	3/27/2025 Date

Significant concerns and explanation of the resolutions are documented within the project file.

As noted above, all concerns resulting from the independent technical review of the document have been fully resolved.

Lisa Jones-Bateman, REM, PMP Senior Program Manager	3/27/2025 Date

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DOCUMENT DISTRIBUTION
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Portage and Trumbull Counties, Ohio

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Craig Kowalski, Ohio EPA-NEDO	Electronic submittal via Ohio EPA File Transfer (Powered by LiquidFiles)
Megan Oravec, Ohio EPA-NEDO	
Tom Schneider, Ohio EPA-SWDO	
Katie Tait, OHARNG	Electronic version posted to DoD SAFE
Kevin Sedlak, ARNG	
Steve Kvaal, USACE – Louisville District	
Rachel Williams, USACE – Louisville District	
Jeremy Renner, USACE – Louisville District	
Jennifer Tierney, Chenega (Administrative Record)	
Jed Thomas – Leidos	Email transmittal letter only
Ryan Laurich – Leidos	

ARNG = Army National Guard
DoD = U.S. Department of Defense
NEDO = Northeast District Office
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
SAFE = Secure Access File Exchange
SWDO = Southwest District Office
USACE = U.S. Army Corps of Engineers

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-Containing Material
AOC	Area of Concern
ARNG	Army National Guard
bgs	Below Ground Surface
CAHES	Certified Asbestos Hazard Evaluation Specialist
CIH	Certified Industrial Hygienist
CJAG	Camp James A. Garfield
CSP	Certified Safety Professional
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
IDW	Investigation-Derived Waste
ISM	Incremental Sampling Methodology
NTCRA	Non-Time-Critical Removal Action
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
P.E.	Professional Engineer
P.G.	Professional Geologist
PARS	PARS Gannett Fleming Joint Venture
PMP	Project Management Professional
QA	Quality Assurance
QC	Quality Control
RACR	Remedial Action Completion Report
REM	Registered Environmental Manager
RI	Remedial Investigation
RAWP	Removal Action Work Plan
RVAAP	Ravenna Army Ammunition Plant
SI	Site Inspection
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	U.S. Army Corps of Engineers
WWA	White Water Associates, Inc.

Note: The above acronym list contains the acronyms used in the Introduction and Worksheets #3 and #5. Each worksheet includes its own acronym list.

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Introduction

Leidos has been contracted by the U.S. Army Corps of Engineers (USACE), Louisville District under USACE Louisville District Contract No. W912QR-21-D-0016, Delivery Order No. W912QR23F0014 to conduct an investigation of asbestos-containing material (ACM) and asbestos-contaminated soil at the CC RVAAP-78 Quarry Pond Surface Dump within the former Ravenna Army Ammunition Plant (RVAAP), now known as Camp James A. Garfield (CJAG). The Army National Guard (ARNG) and Ohio Army National Guard (OHARNG) manage the environmental investigation at the former RVAAP, now CJAG. The Ohio Environmental Protection Agency (Ohio EPA) is the supporting state regulatory agency.

A Site Inspection (SI) was conducted at CC RVAAP-78 Quarry Pond Surface Dump with sampling conducted in 2011, as summarized in the *Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump* (USACE 2016) (herein referred to as the SI Report), and in 2013, as summarized in the *Site Inspection Addendum for CC RVAAP-78 Quarry Pond Surface Dump* (USACE 2018) (herein referred to as the SI Addendum). The SI Addendum concluded that there was no chemical contamination above what is required to attain Unrestricted (Residential) Land Use. However, the SI recommended that Debris Piles A, B, and C and Test Pit 5 be removed and disposed of due to the presence of ACM and/or asbestos in soil.

The *Engineering Evaluation/Cost Analysis: CC RVAAP-78 Quarry Pond Surface Dump* (USACE 2019, herein referred to as the Engineering Evaluation/Cost Analysis [EE/CA]) evaluated removal action alternatives for removing debris, including ACM and asbestos-contaminated soil, at the CC RVAAP-78 Quarry Pond Surface Dump area of concern (AOC). Alternative 2 – Excavation with Offsite Disposal to Attain Unrestricted (Residential) Land Use was the recommended alternative and included removing debris and comingled soil at Debris Piles A, B and C; removing ACM and soil at Test Pit 5; and excavating and disposing of subsurface soil at C78SB-021M-0001-SO (1 to 5 feet below ground surface [bgs]), which is one of the one of the subsurface soil vertical incremental sampling methodology (ISM) samples from Debris Pile C.

The *Non Time-Critical Removal Action Work Plan for CC RVAAP-78 Quarry Pond Surface Dump* (PARS 2020, herein referred to as the Removal Action Work Plan [RAWP]) was developed, and in the summer of 2020, the non-time-critical removal action (NTCRA) was conducted. As presented in the *Remedial Action Completion Report Non-Time Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump* (PARS 2021, herein referred to as the Remedial Action Completion Report [RACR]), Debris Piles A and B and the asbestos-contaminated soil associated with Test Pit 5 were successfully removed. The NTCRA also successfully removed and disposed of the southern portion of Debris Pile C from 0 to 2.1 feet bgs. During removal, PARS-Gannett Fleming Joint Venture (PARS) excavated asbestos-contaminated soil to approximately 13 feet bgs at the southwestern corner of sample C78SB-021M-0001-SO, and ACM was still observed at the base of the excavation. To help determine the southern limits of the debris pile, PARS continued to excavate approximately 15 feet to the south of the soil excavation limits proposed in the RAWP (PARS 2020). ACM was observed from 3 to 8 feet bgs in all three of the excavation sidewalls, indicating that asbestos impacts continue to the east, west, and south of the limits indicated in the EE/CA (USACE 2019). Due to the unknown horizontal and vertical extent of buried ACM, further excavation was not conducted.

SCOPE

The scope of work, as presented in this Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), is to develop a plan to define the remaining extent of ACM and asbestos-contaminated soil in and around Debris Pile C within the Quarry Pond Surface Dump. This consists of five inter-related tasks: 1) prepare a UFP-QAPP, 2) conduct trenching to refine the extent of ACM in Debris Pile C, 3) conduct soil sampling to refine the extent of asbestos-contaminated soil in Debris Pile C, 4) conduct data validation and laboratory oversight activities, 5) complete a combined Remedial Investigation/Feasibility Study (RI/FS) Report. The RI portion of the report will present the results of this investigation and will not require calculation of risks. The FS portion of the report will develop and evaluate remedial alternatives to address all ACM and asbestos-contaminated soil required to achieve project cleanup goals in Debris Pile C. Leidos is the prime contractor leading the investigation. Additional Leidos team members for this project include laboratory analytical services provided by White Water Associates (WWA)/Eurofins CEI; trenching services provided by Terra Probe Environmental, Inc.; and investigation-derived waste (IDW) disposal provided by Clean Harbors, Inc.

PROJECT OBJECTIVES

The objectives of the investigation at the site are to:

- Further delineate ACM horizontally and vertically in and around Debris Pile C
- Further delineate asbestos-contaminated soil horizontally and vertically in and around Debris Pile C
- Develop an RI/FS Report that presents the results of the investigation and develops and evaluates remedial alternatives for ACM and asbestos-contaminated soil in Debris Pile C.

Laboratory analyses will be conducted in accordance with project quality assurance/quality control (QA/QC) requirements. The field activities will follow site-specific sampling and health and safety protocols, as identified in the *Accident Prevention Plan for Additional CERCLA Work for Nine AOCs (RVAAP-34, RVAAP-38, RVAAP-42, RVAAP-45, RVAAP-69, RVAAP-70, RVAAP-76, RVAAP-78, and RVAAP-79)* (Leidos 2023).

Ohio EPA correspondences are presented in Appendix F (including Ohio EPA comments to the Draft UFP-QAPP, Army responses to Ohio EPA comments, and Ohio EPA concurrence to the Army's responses).

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

1. Project Identifying Information
   a. CC RVAAP-78 Quarry Pond Surface Dump Remedial Investigation of Asbestos
   b. Camp James A. Garfield, Portage and Trumbull Counties, Ohio
   c. Contract No. W912QR-21-D-0016, Delivery Order No. W912QR23F0014

2. Lead Organization
   a. Army National Guard (ARNG)
      Kevin Sedlak, Restoration Program Manager

      ____
      Signature, Date

   b. U.S. Army Corps of Engineers (USACE) – Louisville District
      Steven Kvaal, Project Manager

      ____
      Signature, Date

   c. USACE – Louisville District
      Jeremy Renner, Contracting Officer's Representative

      ____
      Signature, Date

3. Other Stakeholders – None

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

PARS (PARS-Gannett Flaming Joint Venture). 2020. *Final Work Plan Non Time-Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio*. April 29.

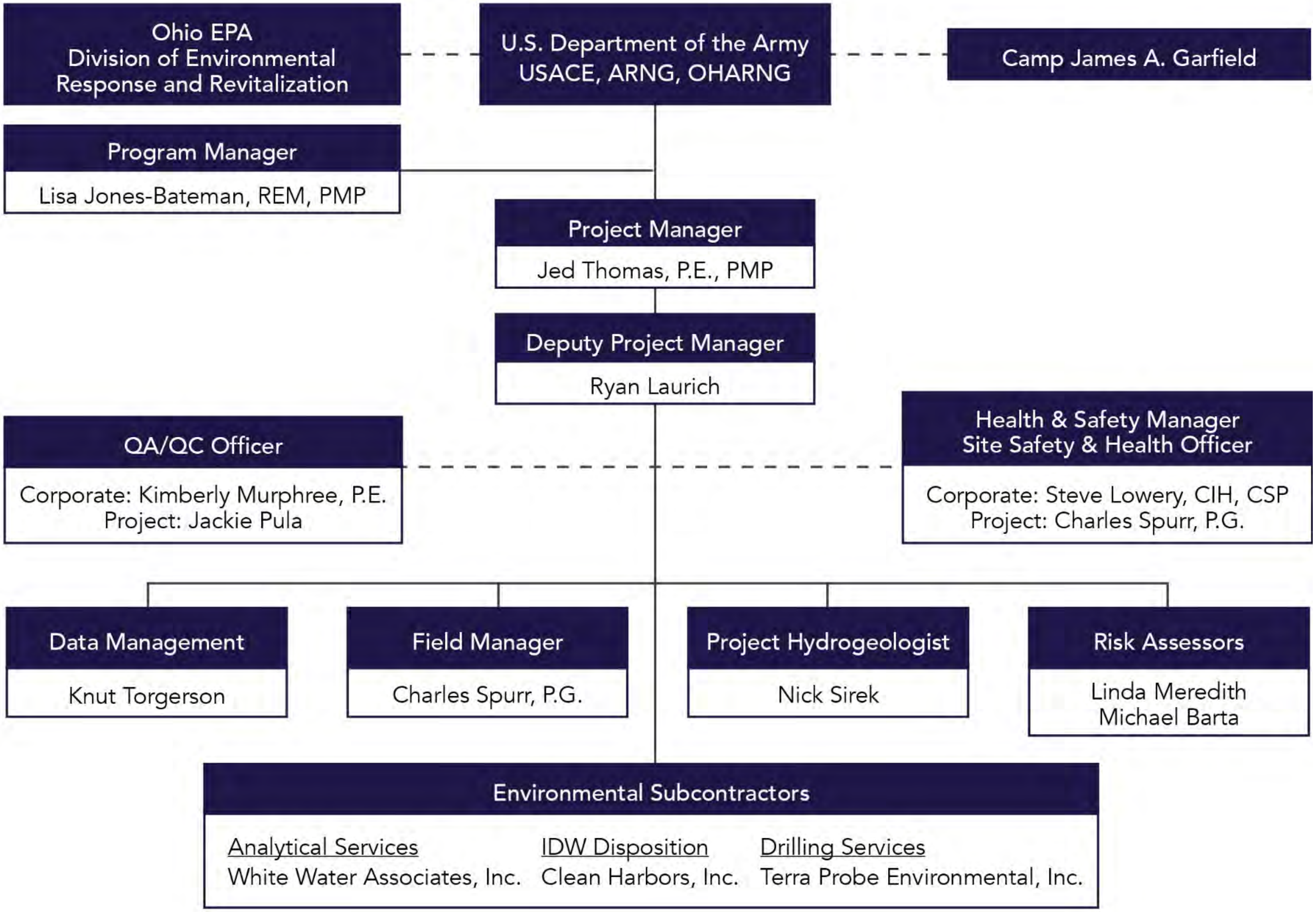
PARS. 2021. *Final Remedial Action Completion Report Non Time-Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio*. April 13.

USACE (U.S. Army Corps of Engineers). 2016. *Final Revised Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ravenna, Ohio*. August 5.

USACE. 2018. *Final Site Inspection Addendum for CC RVAAP-78 Quarry Pond Surface Dump Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio*. September 28.

USACE. 2019. *Final Engineering Evaluation/Cost Analysis: CC RVAAP-78 Quarry Pond Surface Dump at Former Ravenna Army Ammunition Plant, Camp James A. Garfield, Portage and Trumbull Counties, Ravenna, Ohio*. September 19.

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



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

Organization: Leidos

Project Personnel	Title/Role	Education/Experience	Specialized Training/Certifications	Additional Required Training	Signature[b]
Jed Thomas, Leidos	Project Manager	M.S., Chemical Engineering 21 years of experience	P.E., PMP, HAZWOPER Supervisor[a]	None	
Ryan Laurich, Leidos	Deputy Project Manager	M.S., Environmental Science 15 years of experience	HAZWOPER 40-Hour Supervisor[a]	None	
Charles Spurr, Leidos	Field Manager and Project Health and Safety Officer	M.S., Geology/Geophysics 6 years of experience	P.G., HAZWOPER Supervisor[a]	None	
Jackie Pula, Leidos	Project Chemist	B.S., Geology 16 years of experience		None	
Nick Sirek, Leidos	Project Hydrogeologist	M.S., Hydrogeology 16 years of experience	HAZWOPER 40-Hour	None	
Linda Meredith, Leidos	Human Health Risk Assessor	B.A., Chemistry 35 years of experience		None	
Michael Barta, Leidos	Ecological Risk Assessor	M.S., Zoology 30 years of experience		None	
Kimberly Murphree, Leidos	Corporate QA/QC Officer	B.S., Civil Engineering 24 years of experience	P.E.	None	
Knut Torgerson, Leidos	Data Manager	B.S., Environmental Sciences 27 years of experience		None	
Steve Lowery, Leidos	Project Safety and Health Manager	M.S., Industrial Hygiene 28 years of experience	CIH, CSP, HAZWOPER Supervisor, OSHA 510, 40-hour EM 385-1-1 USACE Safety & Health	None	

[a]All field personnel scheduled for fieldwork at CJAG have been trained in accordance with HAZWOPER (29 CFR 1910.120, 29 CFR 1926.65) and are enrolled in a medical surveillance program that meets the requirements of 29 CFR Section 1910.120(f). All personnel are experienced in hazardous waste site work, use of PPE, and emergency response procedures.
[b]Signatures indicate personnel have read and agree to implement this UFP-QAPP as written.

B.A. = Bachelor of Arts
B.S. = Bachelor of Science
CFR = Code of Federal Regulations
CIH = Certified Industrial Hygienist
CJAG = Camp James A. Garfield
CSP = Certified Safety Professional
EM = Engineer Manual
HAZWOPER = Hazardous Waste Operations and Emergency Response
M.S. = Master of Science
OSHA = Occupational Safety and Health Administration
P.E. = Professional Engineer
P.G. = Professional Geologist
PMP = Project Management Professional
PPE = Personal Protective Equipment
QA = Quality Assurance
QC = Quality Control
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan
USACE = U.S. Army Corps of Engineers

QAPP Worksheets #4, #7, and #8 – Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: Laboratory – Eurofins CEI

Project Personnel	Title/Role	Education/Experience	Specialized Training/Certifications	Signature*
Tianbao Bai, Ph.D., CIH	Laboratory Director	Ph.D. Geology 27 years of asbestos experience	McCrone Research Institute (five related courses) MVA Scientific TEM Training	

*Signatures indicate personnel have read and agree to implement this UFP-QAPP as written.

CIH = Certified Industrial Hygienist
TEM = Transmission Electron Microscope
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan

QAPP Worksheet #6 – Communication Pathways

Communication Drivers	Responsible Entity	Name	Telephone Number/Email Address	Procedure (timing, pathway, etc.)
Primary Contractor and Project Oversight	USACE – Louisville District TM	Jeremy Renner	(502) 315-6708 Jeremy.A.Renner@usace.army.mil	Technical information about the project will be provided to the USACE TM as needed by the Leidos team.
	USACE – Louisville District Project Manager	Steven Kvaal	(502) 315-6316 Steven.Kvaal@usace.army.mil	Information about the project will be provided to the USACE Project Manager as needed by the Leidos team.
	ARNG Restoration Program Manager	Kevin Sedlak	(330) 235-2153 Kevin.M.Sedlak.ctr@army.mil	Information about the project will be provided to the ARNG Program Manager as needed by USACE and/or the Leidos team. In addition, significant corrective actions and/or modifications to the UFP-QAPP will be relayed to the ARNG Program Manager as soon as possible by telephone and/or email.
	OHARNG Environmental Specialist	Katie Tait	(614) 336-6136 Kathryn.S.Tait.nfg@army.mil	Information about the project will be provided to the OHARNG Environmental Specialist as needed by USACE and/or the Leidos team. In addition, significant corrective actions and/or modifications to the UFP-QAPP will be relayed to the OHARNG Environmental Specialist as soon as possible by telephone and/or email.
Regulatory Agency Interface	Ohio EPA Site Coordinator	Craig Kowalski	(330) 963-1170 craig.kowalski@epa.ohio.gov	All materials and information about the project will be provided to Ohio EPA as needed from the ARNG Program Manager or OHARNG Environmental Specialist. In addition, significant corrective actions and/or modifications to the UFP-QAPP will be relayed to the regulatory agencies as soon as possible by telephone and/or email.
	ARNG Restoration Program Manager	Kevin Sedlak	(330) 235-2153 Kevin.M.Sedlak.ctr@army.mil	All appropriate materials and information about the project will be provided to the regulatory agencies by the ARNG Restoration Program Manager. In addition, significant corrective actions and/or modifications to the UFP-QAPP will be relayed to the regulatory agencies as soon as possible by telephone and/or email.

QAPP Worksheet #6 – Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Telephone Number/Email Address	Procedure (timing, pathway, etc.)
	OHARNG Environmental Specialist	Katie Tait	(614) 336-6136 Kathryn.S.Tait.nfg@army.mil	Information about the project will be provided to the OHARNG Environmental Specialist as needed by the USACE TM, USACE Project Manager, and/or Leidos team. In addition, significant corrective actions and/or modifications to the UFP-QAPP will be relayed to the OHARNG Environmental Specialist as soon as possible by telephone and/or email.
	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	All appropriate information requiring regulatory input, approval, or awareness will be provided to ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee). Only with approval from the ARNG/OHARNG will anyone from the Leidos team contact the regulatory agency regarding this project.
Manage all Project Phases and Leidos Primary Point of Contact	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	All appropriate information about the project and technical considerations will be provided to ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee) through distribution of hard copies or electronic versions of the reports and/or through telephone or email.
Submit Deliverables, Monthly Reports, and Billings	Leidos Deputy Project Manager	Ryan Laurich	(330) 998-4246 (cell) Ryan.M.Laurich@leidos.com	Deliverables, Monthly Reports, and billings will be submitted to USACE by the Leidos Deputy Project Manager.
Reporting Data Quality Issues	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Corrective actions or flagging of analytical results will be reported to ARNG, OHARNG, and USACE as needed by the /Leidos Project Manager (or designee) by telephone and/or email.
	Leidos Project Chemist	Jackie Pula	(703) 664-4046 Jacqueline.M.Pula@leidos.com	The need for corrective actions or flagging of analytical results will be reported to the Leidos Project Manager by the Leidos Project Chemist by telephone and/or email as soon as possible after issues are identified.

QAPP Worksheet #6 – Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Telephone Number/Email Address	Procedure (timing, pathway, etc.)
Changes to UFP-QAPP Prior to Fieldwork	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	All information about the project regarding changes to the UFP-QAPP and/or corrective actions will be communicated to the ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee) by telephone and/or email. A Field Change Request will also be provided.
	Leidos Project Chemist	Jackie Pula	(703) 664-4046 Jacqueline.M.Pula@leidos.com	Any necessary changes to the UFP-QAPP based on data quality prior to fieldwork will be communicated to the Leidos Project Manager by the Leidos Project Chemist by telephone and/or email as soon as possible after issues are identified.
Changes to UFP-QAPP Field Sampling Procedures During Fieldwork	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Any necessary changes to the UFP-QAPP and/or requested changes to field sampling procedures based on field conditions will be communicated to ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee) by telephone and/or email. A Field Change Request will also be provided.
	Leidos Field Manager	Charles Spurr	(330) 405-5809 (office) (216) 317-5726 (cell) Charles.Spurr@leidos.com	Any necessary changes to the UFP-QAPP and/or requested changes to field sampling procedures based on field conditions will be communicated to the Leidos Project Manager and Deputy Project Manager by the Leidos Field Manager by telephone and/or email.
Field Progress Reports	Leidos Field Manager	Charles Spurr	(330) 405-5809 (office) (216) 317-5726 (cell) Charles.Spurr@leidos.com	Progress made during execution of the fieldwork will be communicated to the Leidos Project Manager and Leidos Deputy Project Manager by the Leidos Field Manager by telephone and/or email.
Field Corrective Actions	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Field-related problems and/or corrective actions identified while in the field will be communicated to ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee) by telephone and/or email as soon as possible after issues are identified. A Field Change Request will also be provided.

QAPP Worksheet #6 – Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Telephone Number/ Email Address	Procedure (timing, pathway, etc.)
	Leidos Field Manager	Charles Spurr	(330) 405-5809 (office) (216) 317-5726 (cell) Charles.Spurr@leidos.com	Field-related problems and/or corrective actions identified while in the field will be communicated to the Leidos Project Manager and Leidos Deputy Project Manager by the Leidos Field Manager by telephone and/or email as soon as possible after issues are identified.
Stopping Work Due to Health and Safety Issues or Unexpected Field Conditions	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Field-related health and safety issues and/or unexpected conditions identified while in the field will be communicated to ARNG, OHARNG, and USACE by the Leidos Project Manager (or designee) by telephone and/or email as soon as possible after issues are identified.
	Leidos Field Manager	Charles Spurr	(330) 405-5809 (office) (216) 317-5726 (cell) Charles.Spurr@leidos.com	Field-related health and safety issues and/or unexpected conditions identified while in the field will be communicated to the Leidos Project Manager and Leidos SSHO by the Leidos Field Manager by telephone and/or email as soon as possible after issues are identified.
Reporting Laboratory Issues (e.g., Sample Receipt Issues, Data Quality Issues, Laboratory QC Variances, Analytical Corrective Actions, Data Verification Issues)	USACE – Louisville District Chemist	Peter Lorey	(716) 879-4158 Peter.M.Lorey@usace.army.mil	Project chemistry or data quality issues will be communicated to ARNG, OHARNG, and USACE by the USACE Chemist by telephone and/or email.
	Leidos Project Chemist	Jackie Pula	(703) 664-4046 Jacqueline.M.Pula@leidos.com	Sample receipt and data quality issues will be reported to the USACE Chemist as needed by the Leidos Project Chemist by telephone and/or email as soon as possible after the issues are identified.
	Eurofins CEI	Tianbao Bai	(919) 481-1413	All sample receipt and data quality issues will be reported to the Leidos Chemist by telephone and/or email from the WWA Project Manager as soon as possible after the issues are identified.
Data Validation Issues, Including Noncompliance with Procedures or Methods	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Data validation issues, including noncompliance with procedures or methods, will be communicated to ARNG, OHARNG, and USACE as needed by the Leidos Project Manager (or designee) as soon as possible by telephone and/or by email after the issues are identified.

QAPP Worksheet #6 – Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Telephone Number/ Email Address	Procedure (timing, pathway, etc.)
	Leidos QA/QC Officer	Kimberly Murphree	(314) 770-3012 kimberly.c.murphree@leidos.com	All data validation issues, including noncompliance with procedures or methods, will be communicated to the Leidos QA/QC Officer and Leidos Project Manager as soon as possible by telephone and/or by email after the issues are identified.
	Leidos Project Chemist	Jackie Pula	(703) 664-4046 Jacqueline.M.Pula@leidos.com	All data validation issues, including noncompliance with procedures or methods, will be communicated to the Leidos Project Manager by the Leidos Project Chemist as soon as possible by telephone and/or by email after the issues are identified.
Data Review Corrective Actions	Leidos Project Manager	Jed Thomas	(330) 405-5802 (office) (216) 214-2599 (cell) Jed.H.Thomas@leidos.com	Data review corrective actions will be communicated to ARNG, OHARNG, and USACE as needed by the Leidos Project Manager (or designee) by telephone and/or email as soon as possible after the issues are identified.
	Leidos Project Chemist	Jackie Pula	(703) 664-4046 Jacqueline.M.Pula@leidos.com	Any necessary data review corrective actions will be communicated to the Leidos Project Manager by the Leidos Project Chemist by telephone and/or by email as soon as possible after the issues are identified.

ARNG = Army National Guard
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
QA = Quality Assurance
QC = Quality Control
SSHO = Site Safety and Health Officer
TM = Technical Manager
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan
USACE = U.S. Army Corps of Engineers
WWA = White Water Associates, Inc.

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QAPP Worksheet #9 – Project Planning Session Summary

See Appendix E for the Project Planning Session and meeting minutes.

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QAPP Worksheet #10 – Conceptual Site Model

10.1 INTRODUCTION

CJAG is in northeastern Ohio within Portage and Trumbull Counties, approximately 1 mile northwest of the city of Newton Falls and 3 miles east-northeast of the city of Ravenna (Figure 10-1). The facility is a parcel of property approximately 11 miles long and 3.5 miles wide, and bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick, and Berry Roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east.

The former RVAAP/CJAG was used as a load, assemble, and pack facility for munitions. Administrative control of the facility (21,683 acres) has been transferred to the U.S. Property and Fiscal Officer for Ohio and subsequently licensed to OHARNG for use as a military training site. The RVAAP IRP, managed by ARNG and OHARNG, encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP/CJAG.

The Quarry Pond Surface Dump (CC RVAAP-78) is in the southcentral portion of the former RVAAP, now known as CJAG (Figure 10-2), just north of the Fuze and Booster Quarry Landfill/Ponds AOC (RVAAP-16). The Quarry Pond Surface Dump consists of three areas formerly used for dumping, as shown in Figure 10-3. An NTCRA was performed to remove ACM and asbestos-containing soil; however, further delineation of both ACM and asbestos-contaminated soil horizontally and vertically in and around Debris Pile C is required.

10.2 SITE DESCRIPTION

The Quarry Pond Surface Dump is in the southcentral portion of the former RVAAP, now known as CJAG (Figure 10-2), just north of the Fuze and Booster Quarry Landfill/Ponds AOC (RVAAP-16). The Quarry Pond Surface Dump consists of three areas formerly used for dumping, as shown in Figure 10-3. Two of the dumping areas at the Quarry Pond Surface Dump, Debris Piles A and B, were at the bases of steeply inclined rock slopes of the quarry and were removed in 2020 as part of the NTCRA. The third area, Debris Pile C, is flatter and is adjacent to the northwestern end of the northernmost pond associated with the Fuze and Booster Quarry Ponds. According to the EE/CA, Debris Pile C measures approximately 120 by 45 feet.

Aerial photographs from 1951 and 1952 show land disturbance, potential grading, surface debris, and what may have been heavy equipment. Aerial photographs from 1966, 1979, and 1981 show less vegetation in the area northeast of the northernmost pond than what was observed during site reconnaissance.

10.3 PRIOR REPORTS

The *Revised Final Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump* (USACE 2016, herein referred to as the SI Report) determined construction debris with ACM was present in Debris Piles A and B, containing approximately 30 to 40 percent asbestos. Soil samples from Debris Piles A and B had less than 1 percent asbestos. Construction debris and rubble were identified in Debris Pile C, but ACM was not noted. However, a soil sample from Debris Pile C (sample C78SB-021M-0001-SO) had 2 percent asbestos. In addition, various chemicals in soil were detected at concentrations greater than the residential FWCUGs. Accordingly, the SI Report recommended that an RI be completed in the area between Debris Piles A and B, referred to as the Test Pit Area, and the eastern side of the northernmost pond to determine if contamination exists in any fill materials.

The SI Addendum (USACE 2018) was completed to define the size of the debris piles and evaluate the Test Pit Area. Decision units were established around each debris pile at a distance of 30 feet in all directions (30-foot perimeter ring around the debris piles) to help establish the extent of the contamination in each pile since the SI already confirmed that chemical contamination was present in all three debris piles, ACM in Debris Piles A and B, and asbestos-contaminated soil in the subsurface at one location under Debris Pile C. No contamination or asbestos were detected in any of the decision units surrounding the debris piles, and ACM was detected only in Test Pit 5 (located around Debris Pile A). The SI Addendum (USACE 2018) recommended that removal action alternatives be evaluated in an EE/CA as the next phase in the CERCLA process.

Accordingly, the EE/CA (USACE 2019) evaluated removal action alternatives for removing debris, including ACM and asbestos-contaminated soil. Alternative 2 – Excavation with Offsite Disposal to Attain Unrestricted (Residential) Land Use was the recommended alternative and included removing debris and comingled soil at Debris Piles A, B and C; removing ACM and soil at Test Pit 5, which is adjacent to Debris Pile A; and excavating and disposing subsurface soil at C78SB-021M-0001-SO (1 to 5 feet bgs), which is one of the one of the subsurface soil vertical ISM samples from Debris Pile C.

10.4 SOIL EXCAVATION AND RESIDUAL CONTAMINATION

The RAWP (PARS 2020) was developed, and in the summer of 2020, NTCRA activities were conducted. As presented in the RACR (PARS 2021), Debris Piles A and B and the asbestos-contaminated soil associated with Test Pit 5 were successfully removed. The NTCRA also successfully removed and disposed of the southern portion of Debris Pile C from 0 to 2.1 feet bgs, as shown in Figure 10-3.

Excavation of asbestos-contaminated soil at sample C78SB-021M-0001-SO was planned for a 10- by 10-foot area from 1 to 5 feet bgs. During removal, PARS excavated asbestos-contaminated soil to approximately 13 feet bgs at the southwestern corner of sample C78SB-021M-0001-SO, and ACM was still detected at the base of the excavation. To help determine the southern limits of the debris pile, PARS continued to excavate approximately 15 feet to the south of the soil excavation limits proposed in the RAWP (PARS 2020). ACM was observed from 3 to 8 feet bgs in all three of the excavation sidewalls, indicating that asbestos impacts continue to the east, west, and south of the limits indicated in the EE/CA (USACE 2019). Due to the unexpected discovery of ACM in Debris Pile C and the unknown horizontal and vertical extent of buried ACM and asbestos-contaminated soil, further excavation was not completed in Debris Pile C. Additional delineation is required to determine the horizontal and vertical extent of buried ACM and asbestos-contaminated soil in and around Debris Pile C.

ACM = Asbestos-Containing Material
AOC = Area of Concern
ARNG = Army National Guard
bgs = Below Ground Surface

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CJAG = Camp James A. Garfield
EE/CA = Engineering Evaluation/Cost Analysis
FWCUG = Facility-wide Cleanup Goal
IRP = Installation Restoration Program
ISM = Incremental Sampling Methodology
NTCRA = Non-Time-Critical Removal Action
OHARNG = Ohio Army National Guard
PARS = PARS Gannett Fleming Joint-Venture
RACR = Remedial Action Completion Report
RAWP = Remedial Action Work Plan
RI = Remedial Investigation
RVAAP = Ravenna Army Ammunition Plant
SI = Site Inspection

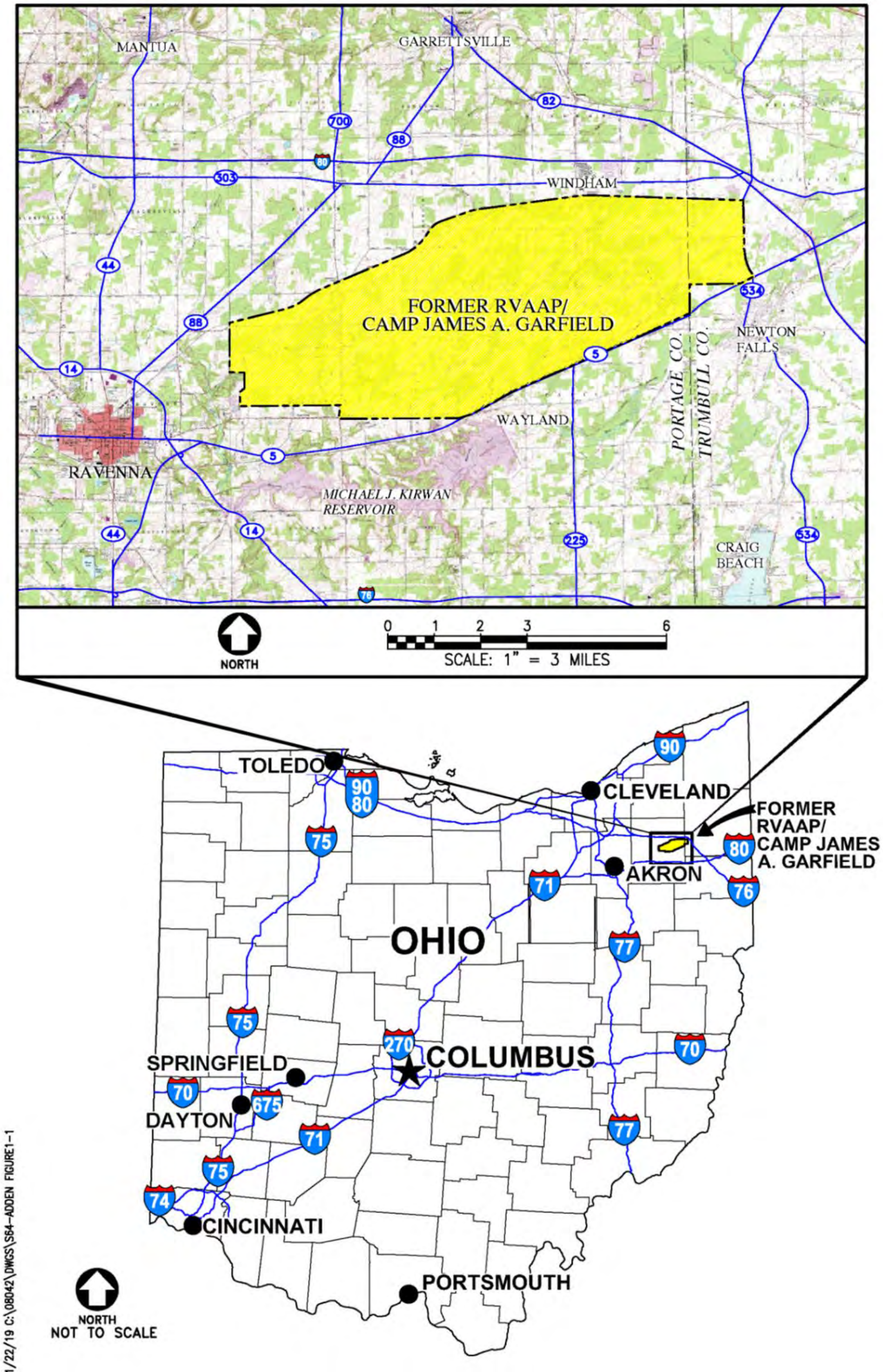

Figure 10-1. General Location and Orientation of Former RVAAP/CJAG

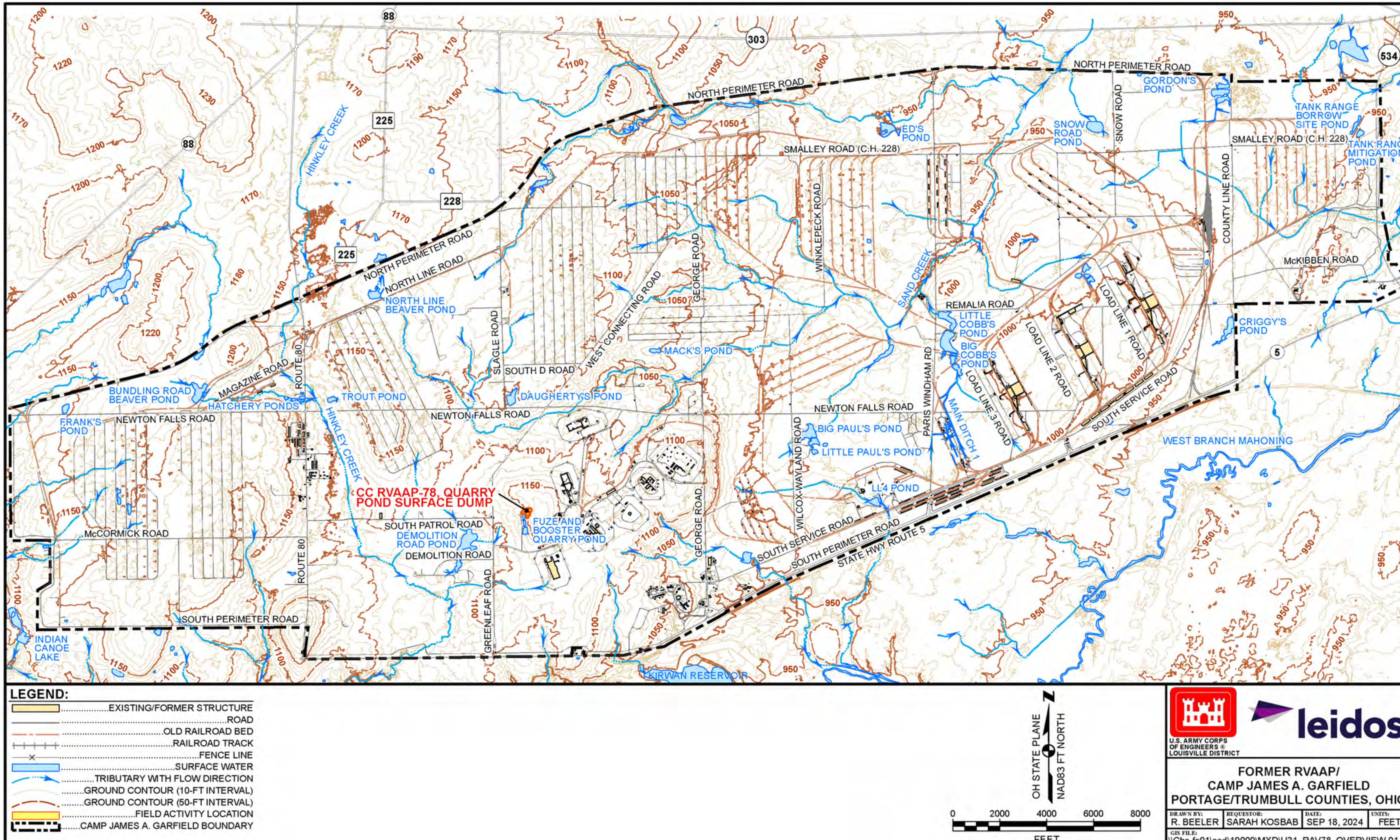

Figure 10-2. Location of CC RVAAP-78 Quarry Pond Surface Dump within Camp James A. Garfield

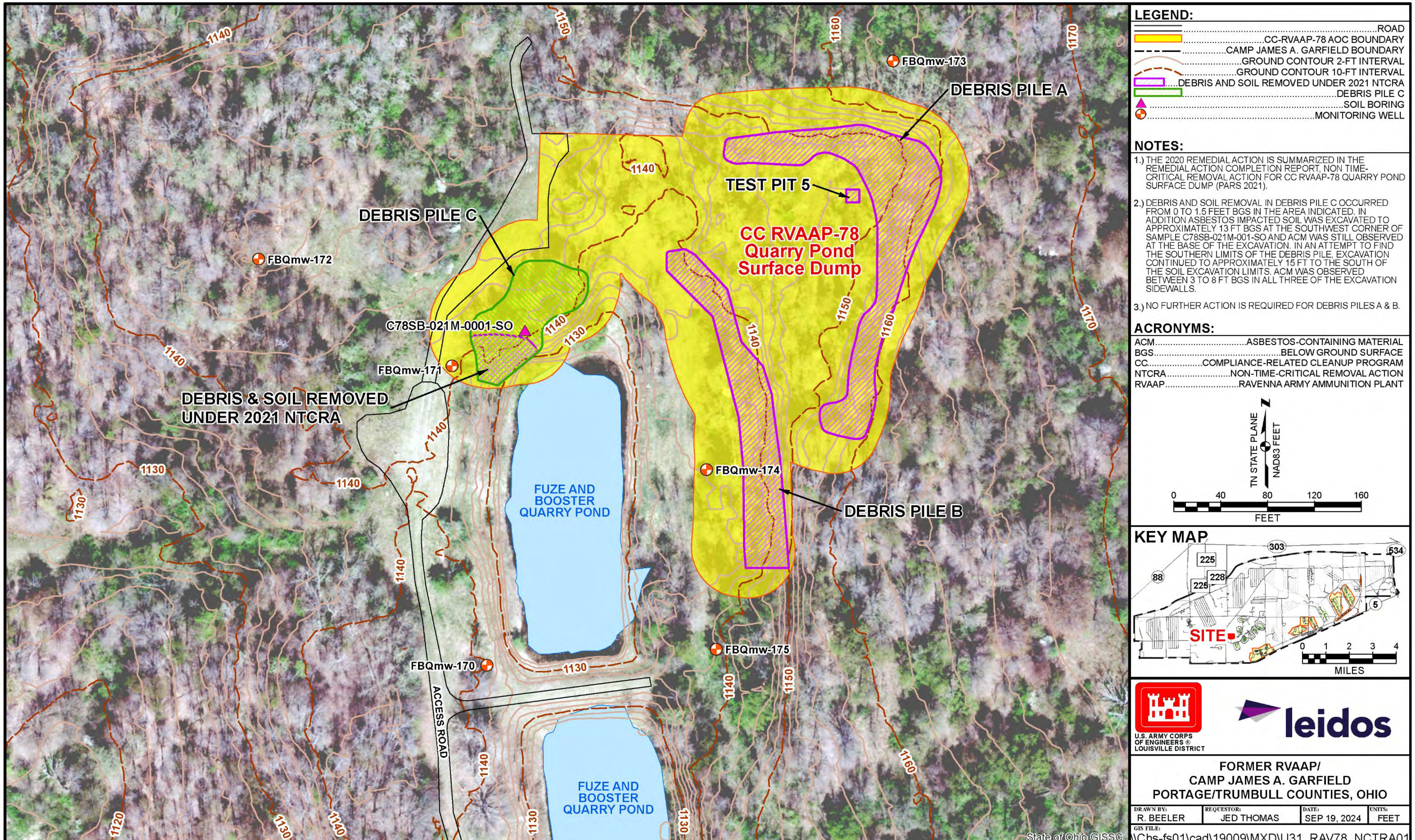

Figure 10-3. Quarry Pond Surface Dump NCTRA Activity Locations

QAPP Worksheet #11 – Project/Data Quality Objectives

11.1 INTRODUCTION

As discussed on Worksheet #10, the RACR (PARS 2021) identified the need to perform trenching to define the extent of ACM and delineation sampling to define asbestos-contaminated soil in and around Debris Pile C at the Quarry Pond Surface Dump. This worksheet documents the problem statement and project goals, identifies the information inputs and boundaries of the field investigation, and provides a high-level overview of the investigative approach. More detailed descriptions of site-specific investigative approaches are presented in subsequent worksheets. Data quality objectives, discussed herein, were developed in accordance with USEPA guidance (USEPA 2006), USACE Technical Planning Process (USACE 1998), and the Optimized UFP-QAPP Worksheets (IDQTF 2012).

11.2 ASBESTOS-CONTAMINATED MATERIAL DELINEATION

11.2.1 Step 1: State the Problem

An NTCRA was performed in 2020 at Debris Pile C to excavate asbestos-contaminated soil, and previously unidentified and unexpected ACM was observed in the excavation. Due to the unexpected discovery of ACM, delineation is required to determine the horizontal and vertical extent of buried ACM in Debris Pile C. Although the SI Addendum (USACE 2018) did not identify ACM in the 30-foot perimeter around Debris Pile C, these areas will be included in the investigation to ensure that all ACM is identified and delineated.

11.2.2 Step 2: Identify the Goals of the Study

The goal of the project is to design an investigative approach to determine the extent of ACM in and around Debris Pile C. The following are the primary goals outlined in this UFP-QAPP:

- Design an investigative approach using trenching to visually identify ACM in the subsurface.
- Under a single mobilization, delineate the horizontal and vertical extent of ACM in multiple trenches in and around Debris Pile C.
- Prepare an RI/FS Report that presents the results of the trenching and horizontal and vertical extent of ACM and develops and evaluates remedial alternatives to address all ACM and asbestos-contaminated soil required to achieve project cleanup goals in Debris Pile C.

The following questions will be addressed during this study:

- Has the horizontal and vertical extent of the ACM in Debris Pile C been delineated?

11.2.3 Step 3: Identify Information Inputs

Primary information inputs on this project will include:

- Historical and site-specific information through document reviews, site planning visits, and conference calls. This includes secondary data listed on Worksheet #13.

- Feedback from regulators obtained during meetings that will share status updates, provide results, solicit input, foster collaboration, and achieve consensus.
- Field observations made during preliminary site visits.
- Field observations made during trenching activities per this UFP-QAPP made by a Certified Asbestos Hazard Evaluation Specialist (CAHES). The CAHES will be certified by the State of Ohio (Ohio EPA) with a valid certificate to perform asbestos sampling and/or oversite duties that are applicable to the certification.
- GPS and professional land surveying data collected during field investigations.

11.2.4 Step 4: Define Boundaries of the Study

This section defines the project's target populations, defines the spatial and temporal boundaries, and specifies the target analytes:

- ***Target Populations***
  - For the delineation of ACM, the target population consists of visual observation of suspected ACM.
  - A sampling unit from this target population would correspond to each decision unit and its associated sample volumes discussed on Worksheets #19 and #30.
- ***Spatial Boundaries***
  - The trenching will focus on Debris Pile C and the area around Debris Pile C, especially to the east, west, and south, to define the horizontal and/or vertical extent of ACM. Current boundaries of these areas are presented in Figure 17-1 on Worksheet #17.
- ***Temporal Boundaries*** – The schedule for the field activities is provided on Worksheets #14 and #16. The field activities will be conducted during the portions of the year when weather conditions are favorable for onsite work in the time required to complete delineation sampling (e.g., optimally April 1 through October 30). If sampling is conducted outside this time frame, biological precautions (e.g., avoid removing bat roosting trees) may need to be taken.
- ***Target Analytes*** – The target analyte is ACM as identified visually by a CAHES.

11.2.5 Step 5: Develop the Analytic Approach

The trenching activities will be overseen by a CAHES. If suspect ACM is identified in the trenches, the CAHES will assess the condition of the ACM, which in turn will determine if it is friable or non-friable. It is intended for trenching to be conducted until the extent of ACM is established. Field investigative activities will be conducted in one mobilization.

11.2.6 Step 6: Specify the Performance and Acceptance Criteria

Performance and acceptance will be achieved through a CAHES assessment of the following:

- The condition of ACM encountered (i.e., poor, fair, good), which will determine if the material is friable or non-friable.

The following performance and acceptance criteria will be used during delineation sampling activities:

- The Field Manager will complete the daily standardized PPE/equipment checklist.

- The Field Manager will verify that field procedures defined in this UFP-QAPP are properly followed daily during fieldwork. The QA/QC Officer or designee will verify field procedures are being conducted appropriately through field audits. Any deviations will be addressed and documented promptly.

11.2.7 Step 7: Develop the Detailed Plan for Obtaining Data

Worksheet #17 provides the basis for proposed sampling, with individual sample details provided on Worksheet #18. Worksheets #19, #20, #24 through #28, and #30 provide specific design analytical requirements.

11.3 ASBESTOS-CONTAMINATED SOIL DELINEATION

11.3.1 Step 1: State the Problem

An NTCRA was performed in 2020 at Debris Pile C to excavate asbestos-contaminated soil, and previously unidentified and unexpected ACM was observed in the excavation. Due to the unexpected discovery of ACM, delineation is required to determine the horizontal and vertical extent of asbestos-contaminated soil in Debris Pile C. Although the SI Addendum (USACE 2018) did not identify asbestos-contaminated soil around Debris Pile C, these areas will be included in the delineation sampling to ensure that all asbestos-contaminated soil is identified and delineated.

11.3.2 Step 2: Identify the Goals of the Study

The goal of the project is to design an investigative approach to determine the extent of asbestos-containing soil in and around Debris Pile C. The following are the primary goals outlined in this UFP-QAPP:

- Design an investigative approach to collect soil samples for asbestos analysis and conduct data validation and interpretation.
- Under a single mobilization, delineate the horizontal and vertical extent of asbestos-contaminated soil in multiple trenches in and around Debris Pile C. Delineation samples will be screened at 1 percent asbestos, as outlined on Worksheet #15.
- Prepare an RI/FS Report that presents the results of the delineation sampling and extent of asbestos in soil, will not require the calculation of risks, and develops and evaluates remedial alternatives to address all ACM and asbestos-contaminated soil required to achieve project cleanup goals in Debris Pile C

The following questions will be addressed during this study:

- Has the horizontal and vertical extent of asbestos-contaminated soil in Debris Pile C been delineated?
- Has the horizontal and vertical extent of asbestos-contaminated soil around Debris Pile C been delineated?

11.3.3 Step 3: Identify Information Inputs

Primary information inputs on this project will include:

- Historical and site-specific information through document reviews, site planning visits, and conference calls. This includes secondary data listed on Worksheet #13.
- Feedback from regulators obtained during meetings that will share status updates, provide results, solicit input, foster collaboration, and achieve consensus.
- Analytical results of the soil sampling outlined on Worksheets #17 and #18.
- Field observations made during preliminary site visits and execution of field activities per this UFP-QAPP.
- Analytical results from the delineation sampling per this UFP-QAPP.
- GPS and professional land surveying data collected during field investigations.

11.3.4 Step 4: Define Boundaries of the Study

This section defines the project's target populations, defines the spatial and temporal boundaries, and specifies the target analytes:

- ***Target Populations***
  - For the delineation sampling, the target population consists of asbestos detected greater than 1 percent in soil samples.
  - A sampling unit from this target population would correspond to each decision unit and its associated sample volumes discussed on Worksheets #19 and #30.
- ***Spatial Boundaries***
  - The delineation sampling will focus on Debris Pile C and the area around Debris Pile C and seek to define the horizontal and/or vertical extent of contamination in soil. Current boundaries of these areas are presented in Figure 17-1 on Worksheet #17.
- ***Temporal Boundaries*** – The schedule for the field activities is provided on Worksheets #14 and #16. The field activities will be conducted during the portions of the year when weather conditions are favorable for onsite work in the time required to complete delineation sampling (e.g., optimally April 1 through October 30). If sampling is conducted outside this time frame, biological precautions (e.g., avoid removing bat roosting trees) will be taken.
- ***Target Analytes*** – The target analyte is asbestos.

11.3.5 Step 5: Develop the Analytic Approach

Soil sampling is necessary to redefine the nature and extent of ACM and asbestos in soil present within the area requiring further investigation. PLM will be used to analyze the samples in accordance with CARB 435, USEPA 600/R-93/116. Worksheet #18 outlines the samples that will be collected and analyzed to meet project goals. Soil is the only environmental medium that will be collected under this investigation.

A screening level of 1 percent asbestos will be used to determine the horizontal and vertical extent of soil contamination. In addition, Worksheet #15 identifies the screening level, detection limits, limits of detection, and limits of quantitation for determining asbestos presence in soil. Field investigative activities will be conducted in one mobilization.

11.3.6 Step 6: Specify the Performance and Acceptance Criteria

Performance and acceptance will be achieved through application of the QA/QC methods and procedures outlined within this UFP-QAPP and ultimately determined through USACE's approval of and regulatory concurrence with the final results, as presented in the RI/FS Report.

The following performance and acceptance criteria will be used during delineation sampling activities:

- The Field Manager will complete the daily standardized PPE/equipment checklist.
- The Field Manager will verify that field procedures defined in this UFP-QAPP are properly followed daily during fieldwork. The QA/QC Officer or designee will verify field procedures are being conducted appropriately through field audits. Any deviations will be addressed and documented promptly.
- The laboratories will adhere to analytical performance/acceptance criteria per method, as defined on Worksheet #12.
- One hundred percent of the data will be examined for completeness (Stage 1 verification). The laboratory submittal will be verified for completeness to ensure that all data requested are present in the data deliverable. Data, as appropriate, will include relevant calibrations and QC information from the laboratory.

11.3.7 Step 7: Develop the Detailed Plan for Obtaining Data

Worksheet #17 provides the basis for proposed sampling, with individual sample details provided on Worksheet #18. Worksheets #19, #20, #24 through #28, and #30 provide specific design analytical requirements.

ACM = Asbestos-Containing Material
AOC = Area of Concern
CAHES = Certified Asbestos Hazard Evaluation Specialist
CARB = California Air Resources Board
FS = Feasibility Study
GPS = Global Positioning System
NTCRA = Non-Time-Critical Removal Action
Ohio EPA = Ohio Environmental Protection Agency
PLM = Polarized Light Microscopy
PPE = Personal Protective Equipment
QA = Quality Assurance
QC = Quality Control
RACR = Remedial Action Completion Report
RI = Remedial Investigation
RVAAP = Ravenna Army Ammunition Plant
SI = Site Inspection
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan
USACE = U.S. Army Corps of Engineers
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #12 – Measurement Performance Criteria

Matrix: Soil		
Analytical Group: Asbestos (CARB 435, PLM USEPA 600/R-93/116)		
Concentration Level: Low		
Data Quality Indicator	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**
Accuracy Bias	Microscope alignment	Alignment performed daily or when the microscope is determined to be out of alignment; criteria specified in laboratory SOP.
Accuracy Contamination	Laboratory prep/method blank	Asbestos fibers not detected.
Accuracy Contamination	Laboratory instrument blank	Asbestos fibers not detected.
Precision	Replicate analysis	+/- 2 standard deviation.
Precision	Duplicate analysis	+/- 2 standard deviation.
Comparability	Use of standardized analytical protocols	Based on documented adherence to UFP-QAPP and laboratory SOP for accredited method.
Representativeness	Sample collection procedures	Based on documented adherence to UFP-QAPP and field SOPs.
Completeness	Reported sample data	90%.

CARB = California Air Resources Board
PLM = Polarized Light Microscopy
QC = Quality Control
SOP = Standard Operating Procedure
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #13 – Secondary Data Uses and Limitations

Data Type	Source	Data Use	Factors Affecting the Reliability of Data and Limitations on Data Use
Facility background information and operational history	USACE (U.S. Army Corps of Engineers). 2016. *Final Revised Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ravenna, Ohio.* August 5. USACE. 2018. *Final Site Inspection Addendum for CC RVAAP-78 Quarry Pond Surface Dump Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio.* September 28.	Contribute to the understanding of historical activities at CJAG and corresponding restoration activities.	• Ongoing evaluation and refinement of knowledge pertaining to the facility-wide CSM, groundwater flow, and bedrock layers. • Interviews conducted with persons with inadequate knowledge of site history. • Personnel who were present at the time of critical events were not available for an interview. • Possible unreported releases.
Historical data, including site photographs and aerial photographs	USACE. 2016. *Final Revised Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ravenna, Ohio.* August 5. USACE. 2018. *Final Site Inspection Addendum for CC RVAAP-78 Quarry Pond Surface Dump Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio.* September 28. USACE. 2019. *Final Engineering Evaluation/Cost Analysis: CC RVAAP-78 Quarry Pond Surface Dump at Former Ravenna Army Ammunition Plant, Camp James A. Garfield, Portage and Trumbull Counties, Ravenna, Ohio.* September 19. PARS (PARS-Gannett Fleming Joint Venture). 2021. *Final Remedial Action Completion Report Non Time-Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio.* April 13.	Contribute to the understanding of historical activities and site conditions as they pertain to potential and/or known contamination source areas.	• Errors in reported analytical or survey data. • Errors in data outputs provided by REIMS.

QAPP Worksheet #13 – Secondary Data Uses and Limitations (Continued)

Data Type	Source	Data Use	Factors Affecting the Reliability of Data and Limitations on Data Use
Existing hydrologic/geologic/ hydrogeologic studies	Facility-Wide Groundwater Monitoring Program	Hydrologic, geologic, and hydrogeologic characterization, inclusive of detailed drawings and hydrogeologic cross-sections, to help understand groundwater flow at CJAG and individual sites.	• Ongoing evaluation and refinement of knowledge pertaining to the facility-wide CSM, groundwater flow, and bedrock layers. • Errors in reported historical data.
Interviews	SAIC (Science Applications International Corporation). 1996. *Preliminary Assessment for the Characterization of Areas of Contamination, Ravenna Army Ammunition Plant, Ravenna, Ohio.* February. Prudent. 2011. *Final Historical Records Review Report for 2010 Preliminary Assessment Compliance Restoration Site CC RVAAP-78 Quarry Pond Surface Dump & CC-RVAAP-80 Group 2 Propellant Can Tops, Prudent, (HRRR).* April. USACE. 2016. *Final Revised Site Inspection for CC RVAAP-78 Quarry Pond Surface Dump, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ravenna, Ohio.* August 5.	Contribute to the understanding of historical activities and site conditions as they pertain to potential and/or known source areas and/or releases to environmental media.	• Interviews conducted with persons with inadequate knowledge of site history. • Personnel that were present at the time of critical events were not available for an interview. • Possible unreported releases.
Analytical data collected during prior investigations	PARS. 2021. *Final Remedial Action Completion Report Non Time-Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio.* April 13. PARS. 2020. *Final Work Plan Non Time-Critical Removal Action for CC RVAAP-78 Quarry Pond Surface Dump, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio.* April 29.	Contribute to the understanding of current ACM and asbestos containing soil throughout the Quarry Pond Surface Dump.	• Errors in reported analytical or survey data. • Errors in data outputs provided by REIMS.

ACM = Asbestos-Containing Material
CJAG = Camp James A. Garfield
CSM = Conceptual Site Model
REIMS = Ravenna Environmental Information Management System
RVAAP = Ravenna Army Ammunition Plant

QAPP Worksheets #14 and #16 – Project Tasks & Schedule

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Delineation Soil Sampling					
Field Schedule Coordination	Leidos/Army	1/6/25	2/28/25		
Field Mobilization	Leidos	3/6/25	3/7/25		
Trenching and Soil Sampling	Leidos	3/8/25	3/24/25	Field Notes Field Scoping Session Summaries	6/30/25
Laboratory Analysis	WWA	3/25/25	3/28/25	Laboratory EDDs	6/30/25
Data Validation	Leidos	3/28/25	4/21/25	REIMS Data Submittal	6/30/25

EDD = Electronic Data Deliverable
REIMS = Ravenna Environmental Information Management System
WWA = White Water Associates, Inc.

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QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

The following sections present the PALs and laboratory-specific detection/quantitation limits for the investigation.

15.1 ASBESTOS-CONTAINING MATERIAL

The PAL for ACM is based on a visual inspection by a CAHES. The CAHES will observe the trenching activities, and if suspect ACM is identified, the CAHES will collect samples to determine the composition of the material. Suspect material will be graded by the CAHES (i.e., fair, poor, or good). The CAHES will make a field determination if the ACM is friable or non-friable based on its condition. The CAHES will direct trenching activities until the extent of ACM in and around Debris Pile C is established.

15.2 ASBESTOS-CONTAINING SOIL

The PAL for asbestos in soil is presented in Table 15-1. The 1 percent threshold in regulations does not necessarily mean that this threshold does not pose an unreasonable risk to human health. However, it is important to note that the 1 percent threshold concept was related to the limit of detection for the analytical methods available at the time and to USEPA's prioritization of resources on materials containing higher percentages of asbestos. Normally, CUGs would be developed by computing the concentration of asbestos in soil that corresponds to an excess cancer risk of 1×10^{-4}. However, such a computation is not currently possible because of the high variability in the relationship between asbestos in soil and asbestos in air. This approach would allow the site to meet Unrestricted (Residential) Land Use criteria without evaluating site-specific parameters and developing a cleanup goal for the ACM or asbestos-contaminated soil (USACE 2019). For a frame of reference, the additional asbestos samples will be compared to the screening level of 1 percent.

Table 15-1. Project Action Limit for Asbestos in Soil

Analyte	Method	CAS Number	Screening Value	Source	Sensitivity	Units
Asbestos	PLM CARB 435 (Level B)	1332-21-4	1%	USEPA Target Level	0.25*	%

*The sensitivity is dependent on the total points counted. The sensitivity reported for asbestos by PLM assumes a 400-point count.

ACM = Asbestos-Containing Material
CAHES = Certified Asbestos Hazard Evaluation Specialist
CARB = California Air Resources Board
CAS = Chemical Abstracts Service
CUG = Cleanup Goal
PAL = Project Action Limit
PLM = Polarized Light Microscopy
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #17 – Sampling Design and Rationale

17.1 INTRODUCTION

This worksheet provides a detailed summary of the investigation design and includes the rationale used to develop the approach. The investigation will determine the extent of ACM and asbestos-contaminated soil in and around Debris Pile C. Field investigative activities will be conducted in one mobilization using test trenching. Soil will be the only medium sampled, and samples will be analyzed for asbestos, as specified on Worksheet #11.

17.2 SAMPLING AREAS AND RATIONALE

The investigation area includes portions of Debris Pile C and the area around Debris Pile C, as discussed on Worksheet #10. The results from historical investigations are discussed in the site-specific CSM within Worksheet #10. The investigation will delineate the horizontal and vertical extent of ACM and asbestos-contaminated soil. The study boundaries will be initially defined based on observed ACM and analytical results compared to the 1 percent screening level provided on Worksheet #15. Ultimately, the study boundary will be defined based on the presence/absence of any asbestos in the analytical results for soil.

The historical data and this investigation will be adequate for completion of an RI/FS. The RI/FS Report will present results of the investigation, will not require calculation of risks, and will develop and evaluate remedial alternatives to address all ACM and asbestos-contaminated soil required to achieve project cleanup goals at Debris Pile C.

17.3 SAMPLING OVERVIEW

The following sections detail the sample naming conventions, sample locations, and types of samples planned for each of the five trenches. Table 17-1 (presented at the end of this worksheet) lists the number of samples proposed for each trench, and Worksheet #18 specifies the sample names and rationale for each sample. Each sample collected during the field effort will be analyzed for asbestos and will receive a unique sample number, as listed on Worksheet #18. Final sample decisions will be based on field conditions. The number for each sample will be in the pattern XXXsb-YYY-ZZZZ-##.

Where:

- XXX = Three-character REIMS facility identification code (e.g., 078 for CC RVAAP-78 Quarry Pond Surface Dump)
- sb = Sample location type (e.g., sb = soil boring)
- YYY = The sequential sample number available for an AOC based on location type (based on REIMS records, the next available soil boring location for CC RVAAP-78 Quarry Pond Surface Dump is "215")
- ZZZZ = The sequential sample number taken from an individual location
  - 0001 = Soil sample located from the 0- to 2-foot bgs interval
  - 0002 = Soil sample collected from the 2- to 4-foot bgs interval

  - 0003 = Soil sample collected from the 4- to 6-foot bgs interval
  - 0004 = Soil sample collected from the 6- to 8-foot bgs interval
  - 000x = Soil sample collected from the (x-1)- to x-foot bgs interval
- ## = Sample matrix type
  - SO = Subsurface soil sample (greater than 2 feet bgs)
  - SS = Surface soil sample (less than 2 feet bgs)
  - WW = Wastewater (IDW).

The RACR (PARS 2021) identified the need to perform an additional investigation to define the extent of ACM and asbestos-contaminated soil in and around Debris Pile C. Five trenches the width of the excavator bucket will be completed in the area requiring further investigation around Debris Pile C. The five trenches are presented in Figure 17-1. Sample quantities are presented in Table 17-1 and described below:

- **078tr-231**: Northernmost location. The trench will start east of Debris Pile C (as east as feasibly possible due to safety concerns and mechanical limitations associated with the slope of the terrain). Trenching will not be completed within the debris pile. The trench will resume on the western side of Debris Pile C, extend to the access road, and then resume from the access road to a distance approximately 20 to 30 feet to the west. Three soil borings will be completed within the trench, and soil will be analyzed for asbestos.
- **078tr-232**: Located south of 078tr-231. The trench will start east of Debris Pile C (as east as feasibly possible due to safety concerns and mechanical limitations associated with the slope of the terrain). Trenching will not be completed within the debris pile. The trench will resume on the western side of Debris Pile C, extend to the access road, and then resume from the access road to a distance approximately 20 to 30 feet to the west. Three soil borings will be completed within the trench, and soil will be analyzed for asbestos.
- **078tr-233**: Located south of 078tr-232. The trench will start west of Debris Pile C, extend to the access road, and resume from the access road to a distance approximately 20 to 30 feet to the west. Three soil borings will be completed within the trench, and soil will be sampled for asbestos. Trenching to the east cannot be completed due to safety concerns and mechanical limitations.
- **078tr-234**: Located south of 078tr-233 and near the southernmost extent of Debris Pile C. The trench will start west of Debris Pile C, extend to the access road, and resume from the access road to a distance approximately 20 to 30 feet to the west. Three soil borings will be completed within the trench, and soil will be sampled for asbestos. Trenching to the east cannot be completed due to safety concerns and mechanical limitations.
- **078tr-235**: Located south of monitoring well FBQmw-171 and the southernmost trench. The trench will start at the east, as close as feasibly possible to the quarry pond, extend west toward the access road, resume from the access road, and extend to a distance approximately 20 to 30 feet to the west. Four soil borings will be completed within the trench, and the soil will be analyzed for asbestos.

Trenches will be completed to 14 feet bgs. Sampling beyond 14 feet bgs is not required and would exceed the mechanical capabilities of the excavator. Visual observations of suspect ACM will be recorded. Soil samples will be collected from the excavator bucket in 2-foot depth intervals beginning at 0 feet bgs and analyzed for asbestos. Because the samples collected within each trench will be from multiple depth intervals, these samples are considered "soil borings" and will be named accordingly. As a result, there will be no "trench" samples. Soil boring locations presented in Figure 17-1 are for graphical purposes only. The location of soil borings in each trench will be determined in the field and biased by the location of suspect ACM encountered during trenching.

Table 17-1. Summary of Proposed Delineation Sampling

			Soil Samples	
RVAAP AOC			**Surface**	**Subsurface**
CC RVAAP-78	Quarry Pond Surface Dump	5	16	96

ACM=Asbestos-Containing Material
AOC = Area of Concern
bgs = Below Ground Surface
CSM = Conceptual Site Model
FS = Feasibility Study
IDW = Investigation-Derived Waste
RACR = Remedial Action Completion Report
REIMS = Ravenna Environmental Information Management System
RI = Remedial Investigation
RVAAP = Ravenna Army Ammunition Plant

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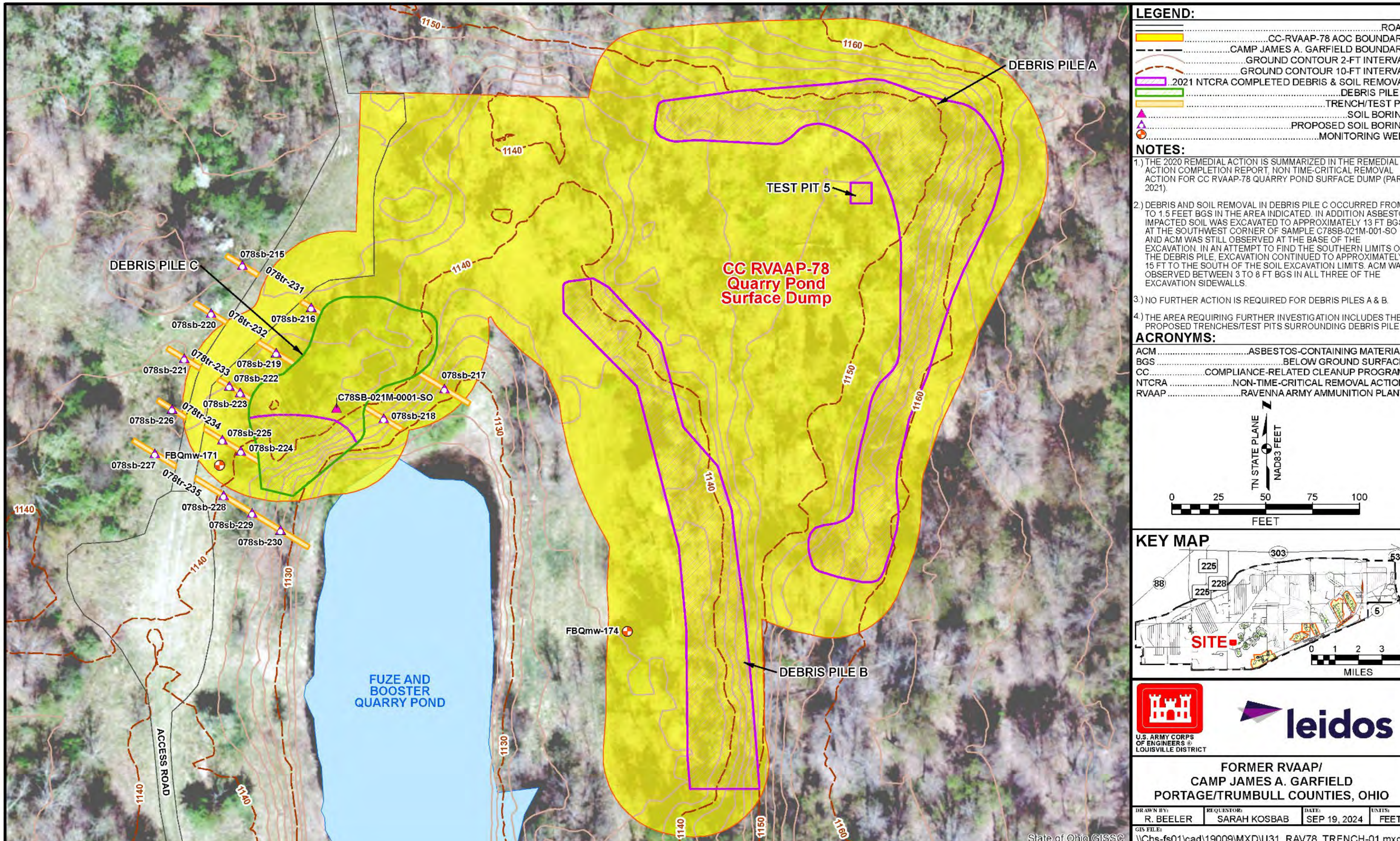

Figure 17-1. Proposed Sample Locations for CC RVAAP-78 Quarry Pond Surface Dump

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QAPP Worksheet #18 – Sample Locations and Methods

18.1 INTRODUCTION

This worksheet provides the sample location names and investigative methods. Sample locations are presented and discussed on Worksheet #17. Investigative methods and SOPs are presented in Appendix B. All samples will be analyzed in accordance with the guidance provided on Worksheets #11, #12, #15, #19, #20, and #30.

18.2 SAMPLE LOCATION NUMBERS AND SAMPLE IDs

This section presents the location numbers for each trench, sample location, and sample IDs proposed for Debris Pile C within the Quarry Pond Surface Dump, as presented in Tables 18-1 and 18-2.

18.3 INVESTIGATIVE METHODS

The following sections provide a general overview of the investigative methods and procedures to conduct the delineation sampling. In general, sampling protocols will follow the Facility-Wide Sampling and Analysis Plan (SAIC 2011). The CJAG utility clearance procedures are presented in Appendix A. All work will stop in the event artifacts or human remains are encountered during trenching and/or soil sampling activities. The field staff will follow the OHARNG guidance provided under the OHARNG Procedures for Inadvertent Discovery of Cultural Materials, as presented in Appendix D.

18.3.1 Access and Coordination

Leidos employees are or will become familiar with and obey the regulations of the facility, including emergency, traffic, spill response, environmental, safety, and security regulations, while on the facility. All Leidos field personnel will be HAZWOPER-trained. Leidos employees will always carry Government-issued photographic identification and will ensure compliance with all regulations and orders of the facility that may affect performance.

Leidos employees will not enter restricted areas unless work activities require entry and only with prior approval from the CJAG Environmental Office. Leidos will coordinate with Range Control daily during field activities. This coordination includes notifying Range Control when field staff enter and exit CJAG. Leidos will also provide any necessary project schedules and maps to Range Control.

Leidos will conduct fieldwork within the core work hours for contractors. These core work hours are Monday to Friday from 7:00 a.m. to 4:00 p.m., not including Federal holidays. Leidos must request (72 hours in advance) and obtain approval from the CJAG Environmental Office and Range Control for any work at CJAG performed outside these core work hours.

Leidos will coordinate with the ARNG Restoration Program Manager and OHARNG Environmental Specialist for access to the facility and to available infrastructure (e.g., buildings, roadways, other facilities). Leidos will provide sanitary facilities for its employees.

Leidos' work areas will always be kept clean and orderly. Debris and waste material will be cleaned up daily and at the end of the project. The contractor is responsible for containerizing all wastes and trash. Leidos will have spill kits with appropriate absorbents, plastic bags, drums, shovels, and other supplies and equipment suitable to clean up any releases or spills from work activities.

18.3.2 Wetlands Delineation and Stream Avoidance Management

To ensure wetlands are avoided during soil sampling activities, a wetlands biologist will perform a site visit of the proposed sampling locations and temporary access routes. If wetlands are observed, access routes and soil boring locations will be altered. In addition, soil samples may be collected via hand auger if soil boring locations are not accessible by the excavator. An initial review of available data indicates wetlands are not near the project site. It is not anticipated that a stream or ditch will be crossed to access trench and sample locations. Crane mats will be used if a stream or ditch must be temporarily crossed to access a sampling location.

18.3.3 Implementation of Best Management Practices

The area to be disturbed by trenching and sampling is anticipated to be smaller than 1 acre, and an SWPPP is not needed. However, Leidos and the CAHES subcontractor will implement both structural and non-structural BMPs for erosion and sediment control, which will include:

- Non-structural BMPs at the project site will include:
  - Minimizing disturbance
  - Maintaining good housekeeping practices.
- Structural BMPs at the site will include:
  - Silt fence (or wattles)
  - Temporary stabilization measures
  - Plastic sheeting beneath and around soil stockpiles.

In addition, to minimize the potential for erosion and sediment runoff, no work will be performed during periods of inclement weather, such as heavy rain or snow, as determined by the field team. In addition, open trenches will be backfilled as quickly as possible once sampling is complete. Due to the narrow nature of the trenches, plastic sheeting may be a viable option to cover the trenches if they are to be left open. In addition, excavation fencing and signage will be placed around open trenches, at least 3 feet away on all sides, to communicate the hazard with workers.

18.3.4 General Sampling Methods

Due to the hazardous nature of friable ACM and asbestos-contaminated soil, field personnel in the exclusion area used for trenching and sampling:

- Will be trained and aware of Respiratory Safety
- Will be fit tested with a 3M 5000 series or similar half-face respirator
- Will have respirators fitted with P100 filters and replaced as necessary.

18.3.5 Trenching Activities

Locations have been chosen to trench around Debris Pile C. Trenches will be advanced using an excavator to 14 feet bgs. Approximate trench locations are presented in Figure 17-1. A CAHES will determine if suspect ACM is uncovered during excavation activities. The CAHES will sample suspect ACM and provide a condition grade to determine if the material is friable. Soils that are removed during trenching will be placed on plastic sheeting, wetted as necessary to prevent generating dust, and covered with plastic sheeting until the trench is complete and the soils can be put back. At the completion of the investigation, the trenches will be abandoned by refilling the trenches with the excavated soil.

18.3.6 Soil Sampling Methods

The Leidos team will collect up to seven soil samples per sample location in a trench to assess for asbestos-contaminated soil. Samples will be collected by a gloved hand from the excavator bucket. Approximate sample locations are indicated in Figure 17-1. The actual location of the samples will be determined in the field during excavation of the trenches to target areas most likely to contain ACM and asbestos-contaminated soil.

All soil sampling activities will be overseen by a CAHES. During the advancement of the trenches, continuous soil samples will be collected and visually examined for evidence of potentially contaminated areas or zones. Approximate sample locations are indicated in Figure 17-1. Samples for laboratory analysis will be collected as a composite of each 2 feet of excavated soil. All sample locations will be mapped with a handheld digital GPS device with sub-meter accuracy prior to demobilization.

Soil from the excavator bucket will be placed into decontaminated stainless steel bowls for homogenization. Homogenization of soil will be completed with stainless steel tools. Samplers will wear new nitrile gloves, changing pairs in between sample collection of specified depth intervals. Alternatively, disposable, one-time use aluminum trays and scoops may be used to process and homogenize soil from each discrete sampling interval. The use of disposable aluminum trays and scoops will reduce the amount of IDW water generated during sampling activities.

18.3.7 Location Surveys

Environmental sample locations and notable site features will be located and mapped using a portable Trimble (or similar) GPS unit capable of achieving ±3-foot accurate results. GPS data will be transferred for use in ArcGIS mapping applications during data evaluation and reporting.

18.3.8 Site Restoration

Leidos and the excavating CAHES subcontractor will restore the site to its original conditions once trenching and sampling are complete. The trenches will be backfilled with the soil and material that was originally removed during the sampling activities. If any ruts or low area remain after backfilling, Leidos and the subcontractor may use small amounts of clean topsoil to fill and cover the depressions. BMPs such as stapled straw mats and straw wattles will be placed around the trenching area to hold soil in place and prevent erosion and runoff. An RVAAP-approved seed mixture will be spread across the disturbed areas. BMPs will remain in place and be maintained until at least 70 percent vegetation coverage is observed and approval is received from the CJAG Environmental Specialist.

18.4 EQUIPMENT DECONTAMINATION

To ensure that chemical analysis results reflect the actual concentrations at sample locations, the non-dedicated, reusable equipment used in sampling activities must be rigorously cleaned and decontaminated between sampling events. The equipment used to conduct sampling activities will be decontaminated before sampling activities begin, between locations, between sampling events, and after sampling activities have been completed. Decontamination guidelines follow the direction provided by USEPA for ACM. Wet cleaning will be used (i.e., reused equipment will be wiped down with a wet cloth).

18.4.1 Sampling Equipment

Non-dedicated sampling equipment; reusable sampling equipment, including stainless steel bowls; and stainless steel sampling tools (e.g., spoons, auger buckets) will be decontaminated prior to initial use and after each use during trench/borehole interval sampling. The procedure for decontamination of sampling equipment will be as follows:

- Wash with approved water and phosphate-free detergent using various types of brushes required to remove particulate matter and surface films.
- Rinse thoroughly with approved potable water.
- Rinse thoroughly with ASTM Type II or equivalent DI/distilled water with analytical certification.
- Allow equipment to air dry as long as possible.
- Place equipment on clean plastic if immediate use is anticipated or wrap in aluminum foil to prevent contamination if storage is required.

Decontamination activities will be conducted in a manner that will allow for the containment and control of all waste decontamination fluids. Every effort will be made to minimize the quantity of waste fluids generated during decontamination activities. Decontamination activities will be conducted at Building 1036.

Some items used during the field activities that do not directly contact sample media may require general decontamination to remove mud, dust, and other items. Items that may require general decontamination include, but are not limited to, shovels, spud bars, and safety-toe boots. These items will be cleaned as appropriate before leaving the site. All waste decontamination fluids and materials will be containerized, labeled, and stored, as described in the IDW Management Plan (Appendix C).

18.4.2 Excavation Equipment

Trenching equipment used to excavate and collect soil samples will be decontaminated within a temporary decontamination pad constructed at the AOC. The decontamination pad will be designed so that all decontamination liquids are contained from the surrounding environment and can be recovered for disposal as IDW. Trenching equipment will be decontaminated prior to each collected sample. The decontamination procedure for trenching equipment is as follows:

- Remove caked soil material from the exterior of the equipment, including the bucket of excavator, using a rod and/or brush.
- Steam clean the equipment interior and exterior with approved water using a brush where steam cleaning is not sufficient to remove all soil material.
- Rinse thoroughly with approved potable water.
- Allow equipment to air dry as long as possible.
- Place equipment on clean plastic if it will be used immediately or wrap in plastic to prevent contamination if storage is required.

Decontamination of excavation equipment will be completed prior to use, between locations, and after final use before departing the site. Excavation equipment used will be decontaminated either by steam cleaning or pressure washing using potable water from an approved source. If a pressure wash is to be used, equipment will be moved to an established decontamination area (OHARNG/ARNG) where the equipment will be pressure or steam washed. Wastewater generated from decontamination activities will be containerized and handled as IDW.

18.5 HAZARDOUS MATERIALS MANAGEMENT

During field activities, it is anticipated that hazardous materials may be used to support sampling. Source containers of decontamination solutions will be stored at Building 1036, with isopropanol being stored in the flammable cabinet and nitric acid being stored in the corrosive cabinet. Decontamination of sampling equipment will be conducted at Building 1036 using plastic containers for cleaning and larger plastic tubs for secondary containment. Spill kits will be kept at Building 1036 in the event of a potential spill. Field activities will follow the OHARNG Environmental Procedures and spill reporting protocols presented in Appendix D.

The excavator and support vehicle are anticipated to carry hazardous materials (i.e., hydraulic fluid, gasoline). The excavator and support vehicle will be required to carry spill kits. The excavator will be inspected daily to ensure there are no broken or leaking hoses and/or connections. Refueling activities will be conducted over secondary containment to ensure any potential spills are contained. Drilling activities will follow the OHARNG Environmental Procedures and spill reporting protocols presented in Appendix D.

Table 18-1. Trench IDs for CC RVAAP-78 Quarry Pond Surface Dump

Sample Location Number	Location Type	Purpose
078tr-231	Trench	Determine the presence of ACM in soil at Quarry Pond Surface Dump.
078tr-232	Trench	
078tr-233	Trench	
078tr-234	Trench	
078tr-235	Trench	

ACM = Asbestos-Containing Material
AOC = Area of Concern
ARNG = Army National Guard
ASTM = ASTM International
bgs = Below Ground Surface
BMP = Best Management Practice
CAHES = Certified Asbestos Hazard Evaluation Specialist
CJAG = Camp James A. Garfield
DI = Deionized
EE = Energy and Environmental
GPS = Global Positioning System
HAZWOPER = Hazardous Waste Operations and Emergency Response
ID = Identifier
IDW = Investigation-Derived Waste
OHARNG = Ohio Army National Guard
RVAAP = Ravenna Army Ammunition Plant
SOP = Standard Operating Procedure
SWPPP = Stormwater Pollution Prevention Plan
USACE = U.S. Amy Corps of Engineers
USEPA = U.S. Environmental Protection Agency

Table 18-2. Sample Location IDs for CC RVAAP-78 Quarry Pond Surface Dump

Sample Location Number	Location Type	Sample ID	Sample Type	Purpose
078sb-215	Soil Boring	078sb-215-0001-SS	Surface Soil (0-2 feet bgs)	Determine the presence of asbestos in soil at Quarry Pond Surface Dump.
		078sb-215-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-215-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-215-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-215-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-215-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-215-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-216	Soil Boring	078sb-216-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-216-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-216-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-216-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-216-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-216-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-216-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-217	Soil Boring	078sb-217-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-217-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-217-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-217-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-217-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-217-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-217-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-218	Soil Boring	078sb-218-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-218-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-218-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-218-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-218-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-218-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-218-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-219	Soil Boring	078sb-219-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-219-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-219-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-219-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-219-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-219-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-219-0007-SO	Subsurface Soil (12-14 feet bgs)	

Table 18-2. Sample Location IDs for CC RVAAP-78 Quarry Pond Surface Dump (Continued)

Sample Location Number	Location Type	Sample ID	Sample Type	Purpose
078sb-220	Soil Boring	078sb-220-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-220-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-220-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-220-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-220-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-220-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-220-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-221	Soil Boring	078sb-221-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-221-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-221-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-221-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-221-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-221-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-221-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-222	Soil Boring	078sb-222-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-222-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-222-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-222-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-222-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-222-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-222-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-223	Soil Boring	078sb-223-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-223-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-223-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-223-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-223-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-223-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-223-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-224	Soil Boring	078sb-224-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-224-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-224-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-224-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-224-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-224-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-224-0007-SO	Subsurface Soil (12-14 feet bgs)	

Table 18-2. Sample Location IDs for CC RVAAP-78 Quarry Pond Surface Dump (Continued)

Sample Location Number	Location Type	Sample ID	Sample Type	Purpose
078sb-225	Soil Boring	078sb-225-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-225-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-225-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-225-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-225-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-225-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-225-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-226	Soil Boring	078sb-226-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-226-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-226-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-226-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-226-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-226-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-226-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-227	Soil Boring	078sb-227-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-227-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-227-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-227-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-227-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-227-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-227-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-228	Soil Boring	078sb-228-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-228-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-228-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-228-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-228-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-228-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-228-0007-SO	Subsurface Soil (12-14 feet bgs)	

Table 18-2. Sample Location IDs for CC RVAAP-78 Quarry Pond Surface Dump (Continued)

Sample Location Number	Location Type	Sample ID	Sample Type	Purpose
078sb-229	Soil Boring	078sb-229-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-229-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-229-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-229-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-229-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-229-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-229-0007-SO	Subsurface Soil (12-14 feet bgs)	
078sb-230	Soil Boring	078sb-230-0001-SS	Surface Soil (0-2 feet bgs)	
		078sb-230-0002-SO	Subsurface Soil (2-4 feet bgs)	
		078sb-230-0003-SO	Subsurface Soil (4-6 feet bgs)	
		078sb-230-0004-SO	Subsurface Soil (6-8 feet bgs)	
		078sb-230-0005-SO	Subsurface Soil (8-10 feet bgs)	
		078sb-230-0006-SO	Subsurface Soil (10-12 feet bgs)	
		078sb-230-0007-SO	Subsurface Soil (12-14 feet bgs)	

ACM = Asbestos-Containing Material
bgs = Below Ground Surface
ID = Identifier

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

Laboratory Name: Eurofins CEI
Laboratory Address: 730 SE Maynard Road, Cary, NC 27511
Point of Contact: Tianbao Bai, Ph.D., CIH
Email and Telephone Number: (919) 481-1413
Sample Delivery Method: FedEx or United Parcel Service

Analyte	Matrix	Method/Standard Operating Procedure	Container(s) (Number, Size, and Type per Sample)	Sample Volume for Analysis	Preservation	Sample Holding Time	Accreditation and Expiration Date
Asbestos	Soil	USEPA 600/R-93/116 CARB 435 SOP 406.01.20	1-gallon zip-lock bag (double bagged)	250 mL (approx. 500-700 g)	None	Indefinite	NVLAP Laboratory Code: 101768-0 Expires: 2024-03-31

CARB = California Air Resources Board
CIH = Certified Industrial Hygienist
NVLAP = National Voluntary Laboratory Accreditation Program
SOP = Standard Operating Procedure
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #20 – Field Quality Control Summary

Table 20-1. RVAAP Quarry Pond Surface Dump Sampling Breakdown

Matrix/Event	Number of Field Samples	Field Duplicate Samples	Field Blanks	Equipment Rinsate Blanks	MS/MSD	Total Analyses
CC RVAAP-78 Quarry Pond Surface Dump	112	12	1	12	6/6	149

Field blanks consist of the source water used during the equipment decontamination process. The source water used for the field blank will be potable water from the site and/or laboratory-provided DI water. A new field blank will be collected and analyzed whenever the source water changes, or every 6 months, whichever occurs first.

Rinsate blanks will be collected at the rate of one per 10 samples when using non-disposable equipment for sample collection.

DI = Deionized
MS = Matrix Spike
MSD = Matrix Spike Duplicate
RVAAP = Ravenna Army Ammunition Plant

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QAPP Worksheet #21 – Field Standard Operating Procedures

Reference Number	Title, Revision, Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work (Y/N)
EE FTP-525	Soil Sampling, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-625	Sample Chain of Custody, Revision 1.1, 12/31/20	Leidos	Varies	No
EE FTP-400	Equipment Decontamination, Revision 1, 12/31/20	Leidos	None	No
EE FTP-175	Field Measurement of Physical and Topographical Features, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-180	GPS Data Collection, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-650	Labeling, Packing, and Shipping Environmental Samples, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-651	Hazardous Materials/Dangerous Goods Shipping, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-655	Analytical Method Selection for Environmental Samples, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-750	Field Measurement Procedures, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-1215	Field Activity Documentation, Revision 2, 12/31/20	Leidos	Varies	No
EE FTP-1220	Documenting Field Changes to Work Plans, Revision 1, 12/31/20	Leidos	Varies	No
EE FTP-1225	Field Demobilization for Investigative Derived Waste, Revision 1, 12/31/20	Leidos	Varies	No
EHS 33.0	Subsurface Asset and Hazard Avoidance, February 2023 Edition	Leidos	Varies	No

EE = Energy and Environmental
EHS = Environmental Health and Safety
FTP = Field Technical Procedure
GPS = Global Positioning System

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

Field Equipment	Activity	SOP Reference	Title or Position of Responsible Person	Frequency	Acceptance Criteria	Corrective Action
GPS	Geographic positioning during trenching and soil sampling activities	EE FTP-180	Leidos Field Sampler	Inspect prior to each use	Start unit and check display for proper geographic positioning; check battery and cable connections	Replace battery, reboot as required

E&E = Environmental Science and Engineering
FTP = Field Technical Procedure
GPS = Global Positioning System
SOP = Standard Operating Procedure

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QAPP Worksheet #23 – Analytical Standard Operating Procedures

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
406.01.20	Standard Operating Procedures Eurofins CEI Method 406: Analysis of Asbestos in Soil Samples by Polarized Light Microscopy. "Preparation and Analysis of Soil Samples by Polarized Light Microscopy Using California Air Resources Board Method 435 and Implementation Guidance Documents"; January 6, 2020	Definitive	Solid	Pulverizing/cutting mill, polarized light microscope	Eurofins CEI	No

SOP = Standard Operating Procedure

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QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
PLM	Microscope alignment	Daily or as needed	Per laboratory SOP	Per laboratory SOP	Eurofins CEI analyst	Eurofins CEI 400.02; 406.01.20
	Refractive index liquids calibration using Cargille calibrated optical glass	Upon opening new bottle and as needed	Accuracy +/- 0.004 (at 22ºC +/- 1ºC)	Per manufacturer	Eurofins CEI analyst	Eurofins CEI 400.02; 406.01.20
	Particle size calibration check	As needed	Particle diameter must be between 10 and 75 micrometers	Equipment or duration time should be adjusted accordingly if the sieve test is not met	Eurofins CEI analyst	Eurofins ECI 400.02; 406.01.20

PLM = Polarized Light Microscopy
QC = Quality Control
SOP = Standard Operating Procedure

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
PLM	Microscope alignment, lens cleaning	Calibration	Per SOP	Daily or as needed	Per manufacturer and laboratory SOP	Per manufacturer and laboratory SOP; return to manufacturer/distributor as needed	Analyst/Supervisor	Eurofins CEI 400.02; 406.01.20

PLM = Polarized Light Microscopy
SOP = Standard Operating Procedure

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

Sampling Organization: Leidos
Laboratories: Eurofins CEI
Method of Sample Delivery (Shipper/Carrier): FedEx or United Parcel Service (fixed-base laboratory)
Number of Days from Reporting until Sample Disposal: 90 days

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Leidos field personnel	FTP-650: Labeling, Packaging, and Shipping Environmental Samples
CoC form completion	Leidos field personnel	FTP-625: Labeling, Packaging, and Shipping Environmental Samples
Packaging	Leidos field personnel	FTP-650: Labeling, Packaging, and Shipping Environmental Samples
Shipping coordination	Leidos field personnel	FTP-650 and FTP-651: Labeling, Packaging, and Shipping Environmental Samples
Sample receipt, inspection, and log-in	Laboratory Sample Custodian	Eurofins CEI QA Manual Section 7.4 "Process Requirements: Handling of Test Items"
Sample custody and storage	Laboratory personnel	Eurofins CEI QA Manual Section 7.4
Sample disposal	Laboratory responsible for disposal of samples 90 days after analysis	Eurofins CEI QA Manual Section 7.4; SOP 400 Section 5.2.8
Nonconformances and corrective actions	Laboratory analyzing samples	Eurofins CEI Quality Policy Manual

FIELD SAMPLE CUSTODY PROCEDURES (SAMPLE COLLECTION, PACKAGING, SHIPMENT, AND DELIVERY TO LABORATORY)

Sample packaging will be performed according to the guidelines in the field technical procedures cited above and provided in Appendix B. To maintain a record of sample collection transfer between field personnel, shipment, and receipt by the laboratory, the applicable sample CoC paperwork is completed for each shipment (i.e., cooler) of packed sample bottles. The team member performing the sampling is personally responsible for the care and custody of the samples collected until they are transferred to the commercial carrier. The Leidos Field Manager will review all field sampling activities to confirm that proper custody procedures are followed during the fieldwork.

All courier receipts and/or paperwork associated with the shipment of the samples will serve as a custody record for the samples while they are in transit from the field to the laboratory. Custody seals should remain intact during this transfer.

When samples are delivered to the laboratory, signatures of the laboratory personnel receiving them and courier personnel relinquishing them will be completed in the appropriate spaces on the CoC record. This will complete the sample transfer.

When samples are shipped via a commercial carrier, coolers will be secured with tape. The tape will seal any drain plug to prevent accidental leakage as the ice pack melts during transport. The tape also will be wrapped around the entire cooler on both ends. Custody seals will be placed across the cooler openings. As custody forms are sealed inside the sample cooler and custody seals remain intact, commercial carriers are not required to sign the CoC.

LABORATORY SAMPLE CUSTODY PROCEDURES (RECEIPT OF SAMPLES, ARCHIVING, AND DISPOSAL)

When the samples are delivered to the laboratory, signatures of the laboratory personnel receiving them and the courier personnel relinquishing them will be completed in the appropriate spaces on the CoC record, unless the courier is a commercial carrier. This will complete the sample transfer.

SAMPLE IDENTIFICATION PROCEDURES

A coding system will be used to identify each sample collected during the field operations of the project (Worksheet #17). This coding system will provide a traceable record to allow retrieval of the information about a particular sample and ensure that each sample is uniquely identified. Each sample will be identified by a unique code that indicates the sample type, sample number, and (in some cases) sample depth.

CoC PROCEDURES

Sample custody and CoC procedures are outlined in the in the procedures cited above and provided in Appendix B.

CoC = Chain-of-Custody
FTP = Field Technical Procedure
QA = Quality Assurance
SOP = Standard Operating Procedure
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan

QAPP Worksheet #28 – Analytical Laboratory Quality Control and Corrective Action

Matrix: Aqueous and Solid
Analytical Group: Asbestos
Concentration Level: Low to High
Analytical Method/Standard Operating Procedure Reference: CARB 435 PLM USEPA 600/R-93/116
Analytical Organization: Eurofins CEI

QC Sample	Frequency/Number	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Laboratory prep blank	One in 50 samples	See Worksheet #12	Per laboratory SOP	Eurofins CEI analyst	See Worksheet #12
Laboratory instrument blanks using salt blank and RI liquid blank	Daily	See Worksheet #12	Per laboratory SOP	Eurofins CEI analyst	See Worksheet #12
Replicate analysis (replicate prepared sample, same analyst)	5% of samples	See Worksheet #12	Per laboratory SOP	Eurofins CEI analyst	See Worksheet #12
Duplicate analysis (same prepared sample, different analyst)	10% of samples	See Worksheet #12	Per laboratory SOP	Eurofins CEI analyst	See Worksheet #12

CARB = California Air Resources Board
PLM = Polarized Light Microscopy
QC = Quality Control
SOP = Standard Operating Procedure
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #29 – Project Documents and Records

Record Type	Generation	Verification	Storage Location/Archival
Readiness Review Checklist	Leidos Task Manager	Leidos Project Manager	Projects Drive*
Readiness Review Action Item Memorandum	Leidos QA/QC Officer	Leidos Project Manager	Projects Drive*
Planning Documents (e.g., UFP-QAPP, HASP)	Leidos Deputy Project Manager	Leidos Project Manager	Projects Drive*
Field Logbook	Leidos Field Manager	Leidos Project Manager	Projects Drive*
Sample Coordinates	Leidos Field Manager	Leidos Project Manager	Projects Drive*
Identification of Field and QC Samples, Sample Labels	Leidos Sample Manager	Leidos Task Manager and Project Chemist	Projects Drive*
Variance Request Forms, Field Change Requests	Leidos Field Manager	Leidos Project Manager	Projects Drive*
CoC Records	Leidos Sample Manager	Leidos Field Manager	Projects Drive*
Sample Shipping Records	Leidos Sample Manager	Leidos Field Manager	Projects Drive*
Digital Photographs	Leidos Field Manager	Leidos Project Manager	Projects Drive*
Field Calibration Logs	Leidos Field Manager	Leidos Project Manager	Projects Drive*
Equipment Inspection Forms	Leidos Field Manager	Leidos Project Manager	Projects Drive*
Laboratory Sample Receipt Forms	Laboratory	Leidos Project Chemist	Projects Drive*
Laboratory Analytical Records and Reports (Full Level IV Data Package, see Worksheet #35)	Laboratory	Leidos Project Chemist	Projects Drive*
Equipment Maintenance Records, if required	Laboratory	Leidos Project Chemist	Projects Drive*
Source Documentation on Standards, if required	Laboratory	Leidos Project Chemist	Projects Drive*
QA/QC Records (e.g., control charts), if required	Laboratory	Leidos Project Chemist	Projects Drive*
Laboratory EDDs (ADR.net, excel)	Laboratory	Leidos Data Manager	Projects Drive*
REIMS Error Logs and Submittal Documentation	Leidos Data Manager	Leidos Project Manager	Projects Drive*
Nonconformance and Corrective Action Reports	Leidos QA/QC Officer	Leidos Project Manager	Projects Drive*
Data Verification Report	Leidos Data Validation Staff	Leidos Project Manager	Projects Drive*
DUA Report	Leidos Project Chemist	Leidos Project Manager	Projects Drive*
Technical Reports	Leidos Deputy Project Manager	Leidos Project Manager	Projects Drive*
Document Review Records	Leidos Independent Technical Reviewer	Leidos Report Writer, Leidos Project Manager	Projects Drive*

*The 'projects drive' is a Leidos secure network data storage server that is a maintained and secure designated location for storing records, data, reports, and Leidos internal protocols. The project drives undergo regular backup to a secure location and records are designated for lifetime storage.

CoC = Chain-of-Custody
DUA = Data Usability Assessment
EDD = Electronic Data Deliverable
HASP = Health and Safety Plan
QA = Quality Assurance
QC = Quality Control
REIMS = Ravenna Environmental Information Management System
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan

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QAPP Worksheets #31, #32, and #33 – Assessments and Corrective Actions

Assessments:

Assessment Type	Responsible Party and Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Readiness Review	Leidos Task Order Manager	One assessment 1 week prior to mobilization	To be determined	Readiness Review Checklist	24 hours following assessment
Sample Collection and Documentation	Leidos Field Manager	Daily during field activities	--	None	None
Health and Safety	Leidos Site Safety and Health Manager	Once during field activities, if warranted	--	Surveillance	1 week following assessment
Field Quality Surveillance	Leidos Field Manager	Once during field activities, if warranted	--	Surveillance	1 week following assessment

Assessment Response and Corrective Action:

Assessment Type	Responsibility for Responding to Assessment Findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Readiness Review	Task Order Manager	Readiness Review Corrective Action Response	24 hours from receipt of Readiness Review	As directed by the Project Manager	
External accreditation program	Laboratory QA Manager	Per accreditation bodies	Per accreditation bodies	Technical personnel in appropriate departments	Laboratory QA Manager

QA = Quality Assurance

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QAPP Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)*
Planning Documents/Records			
1	Approved Work Plan Addendum	**X**	
2	Approved UFP-QAPP and Appendices	**X**	
3	Laboratory contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
6	Leidos administrative and data management SOPs (if applicable)*	**X**	
Field Records			
7	Field logbooks	**X**	**X**
8	Equipment calibration records	**X**	**X**
9	CoC forms	**X**	**X**
10	Drilling logs (if applicable)	**X**	**X**
11	Field change requests (if required)	**X**	**X**
12	Nonconformance Reports/Corrective Action Reports (if applicable)	**X**	**X**
13	Field QA surveillance (if applicable)		
Analytical Data Package			
14	Cover sheet with identifying information	**X**	**X**
15	Case narrative with definition of qualifiers	**X**	**X**
16	Sample receipt information and CoC	**X**	**X**
17	Sample results	**X**	**X**
18	Blank summaries*	**X**	
19	Laboratory reference/control summary, as applicable*	**X**	
20	Instrument calibration (if required)*	**X**	
21	Analytical raw data*	**X**	
22	Required laboratory signatures.	**X**	**X**
23	Nonconformance Reports/Corrective Action Reports (if applicable)	**X**	

Note: Leidos SOPs and Eurofins CEI SOPs are provided in Appendix B.

*Information will be reported but only reviewed if Stage 1 verification/validation indicates it necessary.

CoC = Chain-of-Custody
QA = Quality Assurance
SOP = Standard Operating Procedure
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan

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QAPP Worksheet #35 – Data Verification Procedures

Records Reviewed	Requirement Document(s)	Process Description	Responsible Person, Organization
Field logbook	UFP-QAPP Leidos FTP 1215	Verify that records are present and complete for each day of field activities. Verify that all planned samples, including field QC samples, have been collected and that sample collection locations are documented. Verify that meteorological data have been provided for each day of field activities. Verify that changes/exceptions are documented and have been reported in accordance with requirements. Verify that any required field monitoring has been performed and results are documented.	Leidos Field Manager and Project Manager
CoC forms and sample receipt	UFP-QAPP Leidos FTP 625 Eurofins CEI SOPs	CoC forms will be reviewed for accuracy and completeness against the samples packed in the specific cooler(s) prior to shipment and upon receipt by the laboratory. 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 Leidos within 48 hours of sample receipt. The original completed checklist will be transmitted with the final data package. Verify sample receipt confirmation against CoC forms for accuracy and completeness. Verify that sufficient sample volume has been collected and that appropriate type and number of field QC has been collected.	Prior to shipment – Leidos Field Manager or designee Upon receipt by laboratory – Laboratory Project Manager or designee Upon receipt of Laboratory Sample Receipt Confirmation – Leidos Project Chemist or designee
Laboratory data package	UFP-QAPP Leidos SOPs: Analytical; Laboratory Data Collection and Tracking for Environmental Projects; DM-04, Revision 1; December 31, 2020 Data Verification and Validation DM-05, Revision 1; December 31, 2020 Eurofins CEI SOP	Verify data package for completeness, as defined in this UFP-QAPP, for the following: • Cover sheet with identifying information • Case narrative • Sample receipt information and CoC • Sample results • Blank summaries • Reference/control summaries, as applicable • Instrument calibration • Analytical raw data • Required laboratory signatures.	Before release from laboratory – Laboratory QA Manager or designee Upon receipt of data package – Leidos Project Chemist or designee

QAPP Worksheet #35 – Data Verification Procedures (Continued)

Records Reviewed	Requirement Document(s)	Process Description	Responsible Person, Organization
Nonconformance Reports/Corrective Action Reports (if applicable)	UFP-QAPP, Laboratory SOPs, and the appropriate analytical method(s)	Verify that corrective action was implemented according to plan.	Leidos QA Officer

Note: Leidos SOPs and Eurofins CEI SOPs are provided in Appendix B.

CoC = Chain-of-Custody
FTP = Field Technical Procedure
QA = Quality Assurance
QC = Quality Control
SOP = Standard Operating Procedure
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan

QAPP Worksheet #36 – Data Validation Procedures

Data Validator	Leidos
Analytical group/method	Asbestos – CARB 435 PLM USEPA 600/R-93/116
Data deliverable requirements	An electronic data deliverable in Excel® format and Level III data package in PDF form
Analytical specifications/measurement performance criteria	UFP-QAPP Worksheets #12, #15, #19 and 30, #24, and #28
Measurement performance criteria	UFP-QAPP Worksheet #12
Percent of data packages to be validated	100% will undergo Stage 1 verification
Percent of raw data reviewed	None
Percent of results to be recalculated	None
Validation procedure	The Leidos Project Chemist or designee will review the laboratory data packages for completeness of sample-specific information analytical data packages using Leidos procedures EE DM-04 (Rev 1) and EE DM-05 (Rev 1). These packages are generated by a subcontracted commercial laboratory.

CARB = California Air Resources Board
DM = Data Management
EE = Energy and Environmental Division
PDF = Portable Document File
PLM = Polarized Light Microscopy
SOP = Standard Operating Procedure
UFP-QAPP = Uniform Federal Policy-Quality Assurance Project Plan
USEPA = U.S. Environmental Protection Agency

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QAPP Worksheet #37 – Data Usability Assessment

37.1 REVIEW OF THE PROJECT OBJECTIVES AND SAMPLING DESIGN

Any impact of sample collection variations will be reviewed and discussed with respect to data usability in the final report.

37.2 DATA VERIFICATION/VALIDATION OUTPUTS

Precision and Accuracy – Results will be evaluated by the laboratory and any nonconformances will be discussed in the laboratory report narrative; the impact of any nonconformances will be discussed in the final report.

Sensitivity – Results for all samples will be reviewed to ensure reporting in units consistent with project data quality objectives. Any conclusions about the sensitivity of the analyses will be discussed in the final report.

Representativeness – Representativeness will be achieved by using standard sampling and analytical methodologies governing sample collection protocols, sample size, preservation and handling, and methodology; the impact of any nonconformances will be discussed in the final report.

Comparability – Comparability will be achieved by using standard sampling and analysis procedures that can be reproduced in future sampling events; the impact of any nonconformances will be discussed in the final report.

Completeness – A completeness check will be conducted on all data generated by the laboratory. Completeness criteria are presented on Worksheet #12. Completeness will be calculated as the number of data points collected divided by the total number of data points planned.

37.3 IDENTIFY THE PERSONNEL RESPONSIBLE FOR PERFORMING THE USABILITY ASSESSMENT

The Project Manager, with input from the Field Manager, Project Chemist, and other stakeholders, where necessary, will assess the impact of any nonconformances on data usability.

37.4 DESCRIBE HOW THE USABILITY ASSESSMENT WILL BE DOCUMENTED

The Project Manager will include a section in the final report that summarizes the impact of any nonconformances on data usability.

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References

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APPENDIX A

UTILITY CLEARANCE PROCEDURES

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A. Utility Clearance Procedures

Prior to all subsurface activities, contractors must notify and coordinate a utility clearance with the Ohio Army National Guard (OHARNG) Environmental Specialist. While most active Camp James A. Garfield (CJAG) utilities are outside Comprehensive Environmental Response, Compensation, and Liability Act areas of concern, utility clearances are required to ensure that subsurface activities will not damage or otherwise affect operational facility utilities or personnel safety. A request for utility clearance will be submitted to the OHARNG Environmental Specialist 10 business days prior to subsurface activities onsite. The request must describe and illustrate sample locations and activities to be performed so utilities can be adequately marked or cleared. OHARNG will provide the utility clearance as the Ohio Utility Protection Service one-call system is not currently active onsite. In addition, contractors are required to have a third party complete a utility clearance for the designated work areas. If a utility (known or unknown) is discovered (damaged or undamaged) during field activities, work will be stopped immediately and the OHARNG Environmental Specialist, U.S. Army Corps of Engineers (USACE) Contracting Officer's Representative (COR), and Army National Guard (ARNG) Restoration Program Manager will be notified. The OHARNG Environmental Specialist is responsible for coordinating further clearance of the discovered utility. Work will not recommence until the status of the utility (i.e., live, abandoned) has been determined.

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APPENDIX B

STANDARD OPERATING PROCEDURES

B.1 – Leidos SOPs
B.2 – Laboratory SOPs

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B.1 – LEIDOS SOPs

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ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Field Measurement of Physical and Topographical Features

E&E FTP-175, Revision 1

Effective 31 Dec 2020

Approved By:

Michael D. Simms, P.E.
E&E Division Manager

Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

TABLE OF CONTENTS

1. PURPOSE

This Standard Operating Procedure (SOP) provides guidance for the uniform conduct of field measurements of physical and topographic features including surface water levels.

1.1 Scope and Limitations

This procedure applies to the Leidos Energy & Environmental (E&E) Division (including subcontractors) and should be used when conducting land surveys for the purpose of preparing scaled drawings or topographic maps when horizontal and vertical accuracy is required.

This procedure discusses land surveying by traditional methods. Requirements for surveying with Global Positioning System (GPS) equipment are included in E&E FTP-180 "GPS Data Collection". This procedure may be superseded by stricter requirements as specified in the scope of work or other project-specific document.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that all that all applicable regulations and standards are implemented as necessary.

1.3 Definitions/Acronyms

Back Sight or Back Shot – A sighting with a level back to a point of known elevation.

Benchmark – A permanent of semi-permanent physical location of known or assigned elevation.

Total Station – A total station or TST (total station theodolite) is an electronic/optical instrument used in modern surveying and building construction. The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM) to read slope distances from the instrument to a particular point.

Transit – A repeating surveying instrument for measuring horizontal and vertical angles.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting associated activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Verifying personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.

Site Safety and Health Officer

- Providing health and safety information regarding field activities.

Field Manager

- Verifying that personnel perform their assigned duties in accordance with this procedure.
- Verifying compliance with appropriate project-specific requirements.
- Overall management of field activities.

Field Staff

- Performing duties in accordance with this procedure.
- Only personnel with specific training and/or proper licensure in traditional survey methods shall perform surveying activities.

3. HEALTH AND SAFETY

Proper personal protective equipment shall be worn at all times when performing field work. Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment.

Refer to the site- or project-specific Health and Safety Plan for relevant health and safety requirements. Contact the Site Safety and Health Officer and/or the Field Manager with health or safety related questions.

4. EQUIPMENT AND SUPPLIES

Equipment required to perform location and topographical surveys may include the following:

- Electronic Distance Meters (EDM)
- Engineering levels
- Field logbook and/or field forms (see E&E FTP-1215 “Field Activity Documentation”)
- Level rods
- Measuring tapes
- Mechanical tapes
- Optical tape measures
- Personnel protective equipment (Refer to the site- or project-specific Health and Safety Plan for relevant requirements.)
- Range poles
- Reflector prisms
- Stadia rods
- Steel surveyor chain
- Total Stations
- Transits
- Writing utensil (indelible blue or black ink, black ink preferred)

5. PROCEDURE

5.1 Overview

Field measurements of topographic features, water levels, geophysical parameters, and physical dimensions are frequently required during field investigations. The scope of such measurements depends on the purpose of the particular investigation (project-specific).

All sampling locations used during field investigations will be depicted on a scaled drawing, a topographic or other standard map, or be referenced in such a manner that their location(s) are firmly established.

Each field measurement will be traceable to the actual person making the measurement, to the location of the measurement, the date and time of the measurement, and to the field equipment used to make the measurement. Equipment maintenance and calibration records will be kept at the location where the equipment is stored when not in use. Time will be recorded in local time using the 24-hour format (4 digits; 0000 through 2359, no punctuation and no a.m. or p.m. designation), and the time will be recorded to the nearest 5 minutes.

Field reconnaissance should be avoided during inclement weather such as rain, snow, lightning storms, etc.

Any deviations from specified requirements will be justified to and authorized by the PM. Deviations will be sufficiently documented to allow re-creation of the modified process.

5.2 Details

5.2.1 Site Mapping

Site maps should be prepared, as required, for site investigations. Drainage patterns, buildings, storage containers, surface water bodies, point source discharges, sampling locations, and other pertinent features are depicted on a scaled drawing or map. Maps are noted with degree of accuracy (e.g., map prepared by standard engineering topographic mapping techniques, map prepared by approximate distances). In addition, maps are oriented using a north arrow and should contain a descriptive title. Where appropriate, salient points (e.g., sampling points, surface spills, etc.) may be described in a narrative to the map. Such a narrative will provide a description of the point (e.g., 250 feet north of Bridge No. 44 on State Route 94).

In general, maps will be accurate to within ±10% of map scale and compass sightings will be accurate within ±5 degrees, or as specified in the project-specific documents.

Investigations will include photographs of sampling points and pertinent features, if allowed. Photographs will contain information regarding date, time, project, orientation, and name of person taking the photograph. A log of these photographs must be made in the field logbook. Presentation of the photographs in reports will include an orientation map as standard procedure.

Field notes shall be maintained in field logbooks or field forms in accordance with E&E FTP-1215 “Field Activity Documentation”.

5.2.2 Equipment Quality Control Procedures

All field surveying methods using transits, electronic distance meters (EDMs), total stations, and engineering levels are made only by those personnel who have been trained to use them. This includes registered professional engineers, registered land surveyors, and trained technical staff working under their supervision.

Each piece of field equipment (as appropriate) is numbered and a logbook kept containing maintenance and calibration made on the equipment. The following specific maintenance and calibration procedures are used for site mapping equipment:

- Transits, EDMs, total stations, and engineering levels are inspected using procedures outlined in basic surveying textbooks and appropriate user's manuals before use.
- All measuring tapes and mechanical tapes are calibrated against a steel surveyor chain. Steel tapes that are not within 0.10-foot per 100-feet long or cloth tapes not within 0.20-foot per 200-feet will not be used. The shorter carpenter-type steel tapes (6 to 12 feet) will check within 0.10 foot or will not be used (see E&E A12.1 "Control of Measuring and Test Equipment").
- Personnel using an optical tape measure will become proficient in its use by measuring known distances before using this equipment in the field.
- Level rods, stadia rods, range poles, and reflector prisms are checked for warping and/or damage before use.

5.2.3 Ground Elevation Survey (Vertical Control)

Standard engineering leveling techniques, as described in basic surveying textbooks, are used to establish the methodology for providing vertical control. Datum for elevation control is the National Geodetic Vertical Datum, formerly known as 1929 sea level datum, established by the U.S. Coast and Geodetic Survey.

Benchmarks of known elevation are used. If no benchmark is located in the vicinity, an arbitrary temporary benchmark is established on a permanent location (e.g., foundation, corner post). As with all fieldwork, the location of benchmarks used is shown on the site sketch map.

Elevation surveys are conducted to form a closed circuit (i.e., the survey line closes back to a benchmark. One closes a level loop by going from one known elevation monument to a second known elevation monument. Using a second benchmark will aid in identifying potential errors or changes in the starting benchmark. Third order accuracy is obtained on level circuits with an error margin defined as:

Allowable error = (length of level loop in feet / 2640 feet) * 0.05 feet

In general, this means for a one-mile circuit, the closing measurement should be within 0.05 feet of the starting measurement. If the measured error is greater, the level loop must be re-measured. The project-specific documents should define the accuracy required.

Length of sight, or measurement shot, does not ordinarily exceed 250 feet with turning point back shots deviating no more than 50 feet from one another. Turns will be taken through wells, piezometers, surface water, and geologic sampling points.

6. QUALITY ASSURANCE / QUALITY CONTROL

Only personnel with specific training and/or proper licensure in traditional survey methods shall perform surveying activities. QA review of observation, measurements and recordings documented during this procedure must be in accordance with E&E FTP-1215 "Field Activity Documentation".

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 "Project Records Management".

8. REFERENCES

- E&E A12.1, Control of Measuring and Test Equipment
- E&E A17.1, Project Records Management
- E&E FTP-180, GPS Data Collection
- E&E FTP-1215, Field Activity Documentation
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information
  - Section 8 – Updated references.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

GPS Data Collection

E&E FTP-180, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

Kimberly C. Murphree

E&E Division Quality Assurance Manager

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1. PURPOSE

This Standard Operating Procedure (SOP) establishes the minimum requirements for the collection of features and associated coordinates using a mapping grade Global Positioning Systems (GPS) unit in support of field based feature collection activities.

1.1 Scope and Limitations

These data acquisition and data logging procedures are integral to field activities performed by the Leidos Energy & Environmental (E&E) Division where accurate global positioning system (GPS) field data collection with Global Navigation Satellite System (GNSS)-based equipment is required. This procedure should be considered supplementary to instruction manuals provided with the specific GPS equipment utilized during the survey.

If more stringent contractual requirements governing the use and accuracy of GPS exist, those shall take precedence over this SOP.

This SOP is not intended for data acquisition with a mobile device that has not been augmented with a high quality external GNSS antenna. The use of mobile devices (e.g., smartphones, tablets) for GPS data collection is not prohibited, but is not currently addressed in this procedure. If mobile devices are used for spatial data collection, the requirements governing their use must be defined in a project-specific SOP to ensure that required processes and best practices are defined and all project-specific requirements for data accuracy are met.

This SOP is not intended for use by registered surveyors whose work is generally governed by a different set of standards.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions/Acronyms

Base Station – A fixed GNSS receiver established over a known point or benchmark and paired with a radio transmitter to calculate and broadcast differential corrections to a moving or roving GNSS receiver to be integrated into the positional solution in real-time in order to yield highly accurate positioning data in both the horizontal and vertical planes.

Benchmark – U.S. Geological Survey (USGS) monuments, or other feature with a known GPS location. Also referred to as control points.

Differential Correction – Real-time or post processed correction of GPS coordinates. Real-time corrections are typically from a satellite or beacon. Post-processed corrections are typically performed at the end of the day or the end of the project.

ESRI – Geographic information mapping software provided by the Environmental Systems Research Institute.

Global Navigation Satellite System (GNSS) – A constellation of Earth-orbiting satellites that broadcast a timing signal and a data message that includes their orbital parameters (ephemeris data). The core GNSS constellations include the United States Navigation Satellite Timing and Ranging (NAVSTAR) GPS and the Russian Global Navigation Satellite System (GLONASS).

Global Positioning System (GPS) – A satellite-based navigation and radio-positioning system created and operated by the United States Department of Defense. It includes a minimum of 24 operational satellites in 6 orbital paths. Objective is to have at least 4 satellites available at any time and any place. This abbreviation may also be used to refer to the receiver portion of the system only.

GLONASS – Global Navigation Satellite System (Russia)

ITRF – International Terrestrial Reference Frame

NAVSTAR – U.S. Navigation Satellite Timing and Ranging

North American Datum of 1983 (NAD 83) – Standardized horizontal (X and Y axes) control datum for the North American continent based on the Geodetic Reference System (GRS) 1980 ellipsoid. NAD 83 is tied to the North American tectonic plate to minimize changes to coordinate values over time.

North American Vertical Datum of 1988 (NAVD 88) – Standardized vertical (Z axis) control datum for the North American continent.

USGS – United States Geological Survey

World Geodetic System of 1984 (WGS 84) – Standardized worldwide horizontal (X and Y axes) control datum based on the WGS 84 ellipsoid. WGS 84 is tied to the International Terrestrial Reference Frame (ITRF).

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Communicating general and project specific GPS data collection requirements to the field staff.
- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.
- Making provisions for appropriate and adequate instrumentation and verifying it is available to meet technical requirements of the project.
- Providing a process for QC review of data collection records within a reasonable period following the field activity consistent with Section 6, Quality Assurance / Quality Control, of this procedure.

Site Safety and Health Officer

- Providing health and safety information regarding GPS activities.

Field Manager

- Verifying that field team members are trained and capable of collecting field data according to the project specifications.
- Using the appropriate planning tools (e.g., see Mission Planning Tool referenced in Section 8) to support successful collection of needed data.
- Verifying GPS equipment meets project requirements for reference datum, horizontal and vertical accuracy, data entry, durability, battery life, and data storage.
- Performing daily evaluations of system performance relative to specified accuracies and repeatability by examining the system verification findings as described in Section 5.0 of this document.
- Verifying that personnel perform their assigned duties in accordance with this procedure when it is applicable.
- Verifying compliance with the Sampling and Analysis Plan (SAP), as applicable.
- Overall management of field activities.

Field Staff

- Verifying that the GPS equipment is in working order prior to use in the field, with fully charged batteries and sufficient GPS data storage space to meet project requirements.
- Performing the majority of the hands-on operations including mounting, interface with computer systems and verification procedures.
- Verifying that the requirement to log data on the GPS unit is met and that data are downloaded and archived as required (see Section 7).
- Performing assigned tasks in a safe and effective manner according to established operating procedures.
- Attending required training and understanding tasks assigned.
- Using required personal protective equipment.
- Inspecting equipment prior to use for condition and function.
- Reporting unsafe or questionable conditions to a supervisor.

3. HEALTH AND SAFETY

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Proper personal protective equipment shall be worn at all times when performing field work.

Refer to the site- or project-specific Health and Safety Plan for relevant health and safety requirements. Contact the Site Safety and Health Officer and/or the Field Manager with health or safety related questions.

4. EQUIPMENT AND SUPPLIES

The following are general comments regarding GPS equipment:

- The accuracy and repeatability obtained from the GPS system will be critical to obtaining defensible data from field surveys.
- The Leidos approach includes the use of mapping grade equipment and real-time or post-process corrections in order to minimize the uncertainty in the position. Modern GPS units with differential corrections are capable of sub-foot accuracy or better.
- When collecting a GPS position for a single point, it is recommended to collect a minimum of 30 individual position fixes. The coordinates from each position fix are averaged to calculate the coordinates recorded for a single position. Averaging 30 or more position fixes helps to improve the overall accuracy of a single position. GPS position fixes are typically collected at a rate of 1 fix per second.
- GPS error is primarily affected by multipath, atmosphere and the number of positions collected at a single location. PDOP (Position Dilution of Precision) is an indicator of GPS quality, with a value of 6 or less considered sufficient.
- When feasible, the multi-channel receiver will utilize data from GPS and GLONASS, increasing the position resolution over GPS alone and ultimately the accuracy of the raw positional information. The raw satellite data captured by the GNSS receiver generally provides positions with an uncertainty value of 15 feet. (5 meters), but accuracy and repeatability of those positions are greatly enhanced when paired with a source of differential corrections.
- Real-time GPS correction will provide the highest level of accuracy and should be utilized when available. The most common (free) real-time correction is Wide Area Augmentation System (WAAS). Some other real-time correction options are OmniSTAR (subscription fee), US Coast Guard Beacon, and Trimble VRS subscription (subscription fee).
- Accuracy in the horizontal and vertical planes can be improved by connecting an additional antenna. Some newer GPS models can also improve accuracy by integrating highly accurate horizontal and vertical differential correctors to a GPS receiver in real-time by establishing a wireless connection to a commercial or public base station (fee based).

5. PROCEDURE

5.1 Overview

Refer to the manufacturer's instructions for specific details regarding the operation of your GPS equipment.

5.2 Details

5.2.1 Calibration

- Modern GPS equipment generally requires no on-site calibration prior to use.

- In order to verify that the performance and geodetic accuracy of navigation equipment is within expectations, verification exercises will be completed twice daily; at the start and end of each field mapping day (see calibration verification below).
- If significant differences, as defined below, in horizontal position or vertical height are detected during the verification procedure, a full review of the data collected that day will be performed immediately to examine data validity.
- Any data obtained while the system was operating outside of the performance specifications will be isolated from the primary data set and reacquired once the positioning problem has been resolved.

5.2.2 Equipment Setup

- Choose precision GPS equipment that is consistent with investigative requirements.
- Operate the instruments as per manufacturer's instructions and note in the field logbook the make, model and serial number of survey equipment. In the absence of project-specific requirements, the elevation mask should be set to 15 degrees above the horizon.
- Clearly document in the field logbook (see FTP-1215 "Field Activity Documentation") the horizontal reference datum and the vertical reference datum (if applicable) that were used during the survey. If the GPS equipment allows for user selection of a reference datum, verify that the datum selected is consistent with project requirements. If the survey involves navigation to a pre-defined set of waypoints, verify that the reference datum and units selected for the GPS equipment matches the reference datum and units that were used to generate the waypoints.

5.2.3 Point Offsets

- There are occasions when GPS equipment will not be able to provide an accurate position due to factors that are beyond the control of the field team member (e.g., the station is located in a narrow space between two buildings). On these occasions, positions should be captured by determining accurate coordinates for a reference GPS position and the distance and bearing from the reference position to the actual feature location.
- Reference positions should be within the direct line-of-sight to the actual feature location.
- All bearings should be made relative to the GPS antenna and bearings should be measured from both the offset location and from the actual feature location to improve the accuracy of the value.
- Compasses are affected by natural and man-made attractions and efforts should be made to prevent these sources of magnetic distortion from influencing bearing readings.

- The accuracy of distance measurements will directly affect the overall accuracy of the offset position. Distances measured on an incline must be adjusted from slope to horizontal distance.
- Positions located within the interior of a structure, where direct line-of-sight to an accurate GPS fix may not be possible, should be referenced to permanent features of the structure itself that would be visible on an aerial photo (e.g. exterior wall, exterior corner, or chimney).

5.2.4 Calibration Verification

The procedures described below are meant only as a general check to verify that the GPS equipment is working properly. Project specific guidelines will need to be followed in order to meet project accuracy requirements; this may require more detailed calibration procedures with different accuracy criteria.

- Prior to commencing field GPS operations, hold static over a pre-existing benchmark (free of overhead obstructions) of first-order horizontal and vertical (if available) control and collect a minimum of 30 positional fixes in the project survey datum.
- Move the system 50 to 100 feet away from the benchmark for a minimum of 30 seconds.
- Return to the benchmark position and collect a minimum of 30 new positional fixes.
- Compare the two observed positions to the known position of the survey benchmark to verify that differences between the sets of coordinates remain within 15 feet, in the horizontal plane. If the difference between the sets of coordinates exceed 15 feet, then survey operations should be suspended until the reason for this difference is identified and corrected.
- Repeat this verification procedure at the conclusion of daily operations, to confirm continued, normal system operation.
- In the absence of a pre-existing benchmark, calibration verification should be performed by re-observation of a minimum of 10% of representative survey points. These data points should be collected a minimum of one hour after the original readings and by a different individual to maximize the independence. Re-observation may be completed with the same GPS receiver, or one capable of higher accuracy. Use of a higher accuracy receiver is preferred if available. Verify that the same critical settings are used for re-observations. Each re-observed position must be based on a minimum of 30 positional fixes and must not differ from the original position recorded more than 15 feet in the horizontal plane. Survey operations should be suspended until the reason for differences greater than 15 feet are identified and corrected.

6. QUALITY ASSURANCE / QUALITY CONTROL

- Post-processing of GPS data should be performed by a person experienced in appropriate GPS post-processing software. A backup copy of original raw data files should be created prior to post-processing of the data.
- Data shall be reviewed for compliance to contractual requirements, specified guidelines or standards (i.e. positional accuracy, content accuracy, completeness, data format adherence, and data integrity assurance).
- All raw data files, originally corrected and interpreted (originally corrected with edits) GPS data and base station sampling files must be archived in accordance with E&E A17.1 “Project Records Management”. Files must be archived both in the manufacturer’s original, proprietary format and in a standard format such as Excel or delimited text file. Be aware that these standard formats do not necessarily include all file information. It may be necessary to use an ESRI shapefile (or similar) format to capture required data. The goal is to record the information in a non-proprietary, or less proprietary, format that may be accessed without the GPS software.

7. RECORDS

- During the GPS data collection itself, positional data obtained by the GPS is logged in the handheld unit. Data should be downloaded daily using applicable software in the standard manufacturer format.
- An additional backup file should also be made at the conclusion of each day survey data is collected and kept separately on another storage device, such as a Memory Card (when available).
- A new GPS file should be created each day, per project, on the GPS device. A new GPS file should also be created if there is any potential for data file corruption, such as a power failure or the need for a system reset without proper file shutdown.
- At the conclusion of the field activity, after post-processing is complete, data must be transferred to the project files in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- E&E FTP-1215, Field Activity Documentation
- E&E A17.1, Project Records Management
- EHS-48, Stop Work Authority
- GPS Mission Planning (Trimble): http://www.trimble.com/GNSSPlanningOnline

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a major revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.1 – Added statement about accuracy requirements. Added statement about data collection with mobile devices.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information.
  - Section 5 – Reformatted using 3rd level headers.
  - Section 5.2.2 – Added statement regarding waypoint datum.
  - Section 5.2.4 – Added statement regarding accuracy requirements.
  - Section 7 – Updated backup requirements. Added statement about creating a new data file if there is a potential for file corruption.
  - Section 8 – Updated references.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Equipment Decontamination

E&E FTP-400, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
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ATTACHMENT(S)

1. PURPOSE

This Standard Operating Procedure (SOP) establishes the requirements for the decontamination of equipment during field sampling activities. The objective of decontamination is to:

- Remove physical, chemical and radiological contamination from surfaces;
- Minimize the spread of contamination to uncontaminated surfaces;
- Avoid cross-contamination of samples; and,
- Minimize personnel exposures.

The intent is to accomplish the required level of decontamination while minimizing the generation of additional solid and liquid waste.

1.1 Scope and Limitations

This SOP describes general decontamination requirements to be followed by Leidos Energy & Environmental (E&E) Division employees and subcontractors when field decontaminating sampling equipment (e.g., vehicles, drilling equipment, sampling equipment, well materials) for both reuse in the field as well as final decontamination prior to equipment storage or leaving the site. This procedure does not apply to health and safety equipment and personal protective equipment. The mention of trade names or commercial products in this procedure does not constitute an endorsement or recommendation for its exclusive use.

Decontamination procedures may be subject to Federal, State, or local regulations and/or client specific requirements. If a determination is made that the procedures described herein are inappropriate, inadequate or impractical and that other procedures must be used to decontaminate sampling equipment at a particular site, the variant process shall be authorized by the Project Manager (with concurrence from other appropriate personnel such as the Site Safety and Health Officer). Deviations identified before fieldwork begins shall be clearly documented in the Sampling and Analysis Plan (SAP) or other appropriate project-specific document. Deviations identified during fieldwork shall be documented in the field logbook with a description of the circumstance requiring its use.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions/Acronyms

Decontamination – Removal of substances from skin, clothing, or equipment to the extent necessary to preclude the occurrence of foreseeable health effects, environmental effects, or sampling and testing effects.

Deionized Water (DI Water) – Tap water that has been treated to remove ions. Generally, the term “DI Water” is used to refer to water that has been purified in some method to remove contaminants that may interfere with sample analysis. Essentially, water used for the final rinse step in decontamination procedures must not contain contaminants at a concentration high enough to introduce a false positive into the analytical results of a sample. Field and Rinsate Blanks can be used to provide verification.

Equipment – Those items (variously referred to as “field equipment” or “sampling equipment”) necessary for sampling activities.

Field Blank – A sample of DI Water poured into a sample container in the field, preserved and shipped to the laboratory with field samples. Field blanks are used to assess contamination (vehicle exhaust, airborne contaminants, etc.) from field conditions during sampling.

Laboratory Detergent – A standard brand of phosphate-free laboratory detergent, such as Liquinox®, or equivalent.

Organic-Free Water – Tap water that has been purified specifically to remove organic compounds. One of the most common treatment methods is to filter the water through activated carbon. Similar to the DI Water definition, organic-free water is required in situations where organic contaminants in the water may introduce false positives into the analytical results when analyzing for organics.

Rinsate Blank – A sample of DI Water poured over or through decontaminated field sampling equipment prior to the collection of environmental samples. The rinsate water is collected and placed into appropriate sample containers, preserved, and shipped to the lab for analysis as part of the field sampling program. Rinsate blanks are used to assess the adequacy of the decontamination process. Rinsate blanks are sometimes referred to as equipment blanks.

Sampling and Analysis Plan (SAP) – A plan that documents the procedural and analytical requirements for a project that involves the collection of samples to characterize potential areas of contamination. This may be a stand-alone plan or included as a section in another site- or project-specific plan.

Solvent – Pesticide-grade isopropanol is the standard solvent used for decontamination in most instances. The use of other solvents must be justified and approved by the Project Manager and documented in the field logbook.

Tap Water – Water from a potable, municipal water system.

Trip Blank – A clean sample of a matrix that is taken from the laboratory to the sampling site and transported back to the laboratory without being exposed to sampling procedures. Trip blanks are typically only analyzed for volatile compounds, and are used to assess contamination introduced during shipping and field handling procedures.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting applicable activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.
- Approving deviations from this procedure, in coordination with the Site Safety and Health Officer, and verifying deviations are properly documented.

Field Manager (FM)

- Verifying that personnel, including subcontractors, perform their assigned duties in accordance with this procedure when it is applicable.
- Verifying compliance with the SAP during fieldwork.
- Selecting, in coordination with the Site Safety and Health Officer, the appropriate decontamination method that complies with SAP guidelines and regulatory requirements (if applicable).
- Verifying that equipment decontamination is performed in accordance with requirements and that the decontamination method selected is appropriate for the contaminant present as well as the surface and/or material to be decontaminated.
- Managing fieldwork.

Site Safety and Health Officer

- Assisting the Field Manager in determining appropriate decontamination methods to be used.
- Providing guidance on and answering questions about health and safety requirements.
- Assisting the Project Manager in approving required deviations from this procedure on a project-by-project basis.

Field Staff

- Performing decontamination activities in accordance with this procedure and requirements identified in the SAP or other site- or project-specific document.
- Reporting unsafe or questionable conditions and communicating issues encountered to the Field Manager and Project Manager.
- Attending required training and understanding tasks assigned.
- Using required personal protective equipment.
- Inspecting equipment prior to use for condition and function.

3. HEALTH AND SAFETY

Proper safety precautions must be observed when field cleaning or decontaminating field equipment. Decontamination procedures may involve exposure to impacted surface waters or soils via routes of dermal contact and inhalation. At a minimum, the following precautions shall be taken during decontaminating operations:

- Safety glasses or goggles, and nitrile (or equivalent) gloves will be worn while decontaminating equipment.

- No eating, smoking, drinking, chewing, or hand to mouth contact will be permitted during decontamination activities.

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment.

Refer to the site- or project-specific Health and Safety Plan for specific guidance on safety precautions. Questions and/or comments regarding health and safety will be directed to the Site Safety and Health Officer and/or the Field Manager.

4. EQUIPMENT AND SUPPLIES

Required decontamination supplies and equipment are dependent upon the nature of the contaminant and the decontamination method used. The list below includes typical equipment and supplies necessary for general decontamination activities. Refer to the project SAP for specific details regarding required equipment and supplies for project-specific decontamination activities.

- Aluminum Foil
- Brushes
- Chains of Custody (for rinsate/equipment blanks) (see E&E FTP-625 "Sample Chain of Custody)
- Coolers (for storage and shipment)
- DI Water
- Drums
- Emery cloth
- Field Logbook / Field Forms (See E&E FTP-1215 "Field Activity Documentation")
- High-pressure washer
- Laboratory Grade Detergent (non-phosphate)
- Labels
- Organic-free water
- Paper towels
- Plastic bags
- Plastic Sheeting
- Personal protective equipment (Check project-specific Health and Safety Plan for details; however, PPE generally includes, but is not limited to, eye, hand, foot, hearing, and head protection.)
- Sample containers for rinsate/equipment blanks
- Sand-blaster
- Sawhorses/racks (not wood)
- Solvent(s)
- Solvent squeeze bottle/dispenser
- Spray Bottles
- Steam Machine
- Table (not wood)
- Tap water

- Tape
- Trash bags
- Trash container(s)
- Tubs or buckets
- Writing Utensils (indelible blue or black ink, black ink preferred)

5. PROCEDURE

5.1 Overview

A decontamination plan should be developed and sufficiently scoped to address the expected types and levels of contaminants at a site and the methods used to investigate them. The decontamination plan is typically included in the SAP. Until proven otherwise, the decontamination plan should assume that personnel and equipment exiting the area of potential contamination are contaminated and, therefore, comprehensive decontamination procedures must be implemented. The plan should address the number, locations, and layout of decontamination stations; which decontamination apparatus is required; appropriate decontamination methods; and methods for disposal of contaminated equipment and waste liquids. The level of effort required for decontamination of equipment should be determined prior to beginning fieldwork.

Reusable equipment employed in the collection of environmental samples shall be cleaned prior to use to minimize the possibility of introducing contaminants with the potential to bias sample analysis. Sampling activities must be conducted with the utmost care because field contamination has the potential to significantly bias analytical results. Reusable equipment must also be decontaminated between samples to prevent cross-contamination.

Cleaning techniques shall be commensurate with the type of equipment in use, generally consisting of washing with a laboratory grade detergent followed by subsequent rinses of tap water and DI Water. Equipment used to collect samples that will be analyzed for metals may require a nitric acid rinse followed by a DI Water rinse. Sampling equipment to be used to collect samples for organic compounds shall also be rinsed with an appropriate organic solvent. Note that pesticide-grade isopropanol is the standard solvent used for decontamination in most instances. The use of other solvents must be justified and approved by the Project Manager and documented in the field logbook.

When equipment is used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with an approved solvent (one which meets the requirements of the SAP) before initiating decontamination. Extreme cases may require more aggressive methods (e.g., steam clean, wire brush, or sandblasting). If the equipment cannot be adequately cleaned utilizing these means, it will be properly discarded.

For a specific decontamination method used, the substitution of higher-grade water is permitted (e.g., the use of organic-free water in place of DI Water). However, it must be noted that DI Water and organic-free water are less effective than tap water in rinsing away the detergent film during the initial rinse.

If an item has not been successfully decontaminated or cannot be monitored due to its shape (such as inside of a pipe), a decision as to further decontamination measures is made by the Field Manager.

Deviations from the requirements specified in this procedure must be justified to and authorized by the Project Manager. Deviations must be sufficiently documented in the field logbook to allow recreation of the modified process.

The following information is intended only as a general guideline for understanding the relevant concerns pertaining to field equipment and sample device decontamination. The actual selection of decontamination methods and schedules must be based on requirements within the site- or project-specific SAP.

5.2 Determining Appropriate Decontamination Methods

Each decontamination task must be individually assessed based on the characteristics and use of the equipment to be cleaned, including:

- Surfaces and materials of the equipment
- Size of equipment
- Fragility of equipment
- Equipment purpose/use

Assessment will also be based on characteristics of the media to be removed by contamination (e.g., oily sludge, heavy clay, etc.). The assessment must consider potential contaminants of concern (e.g., radioactive vs. chemical contaminants), levels of contamination, sensitivity of sample analysis, and related health and safety issues.

The FM, in coordination with the Site Safety and Health Officer if necessary, selects the decontamination method (as defined herein or in the SAP) deemed most appropriate for a particular task. If results are unsatisfactory, proceed step-by-step in selecting a more extensive method to successfully complete the decontamination. Deviation from plans will be documented in the field logbook and by a field change process if appropriate.

5.2.1 Equipment Categories

It is helpful to discriminate among three categories of field equipment when making decisions regarding decontamination requirements. These three categories of equipment are distinguished by the degree to which they may encounter contaminated media and their potential to indirectly affect sample integrity. Consequently, each of these three categories will usually require different consideration in terms of decontamination schedules and methods used. The table below identifies the three categories and indicates appropriate decontamination methods.

Category	Definition	Type of Decon	Example(s)
1	• Equipment that will not contact the sample • Should not affect sample integrity • Need not contact the contaminated media	Avoid decontamination by keeping clean equipment away from incidental contact with contaminated media (e.g., placing equipment on clean plastic drop cloths, baggies, etc.).	• Ambient air thermometers • Emergency equipment • Field support equipment

Category	Definition	Type of Decon	Example(s)
2	• Equipment that will not contact the sample • Should not affect sample integrity • Will contact the contaminated media	Decontamination between sample locations and decontaminated or packaged before being removed from the site.	• Flow meter used in conjunction with surface water sampling
3	• Equipment that may have an impact on sample integrity due to its function in close proximity to the sample before and during sample collection	Usually decontaminated prior to arrival on site, between sample locations, and most often between samples to avoid cross-contamination (e.g. drilling and digging through area of possible or known contamination.	• Drill rig • Drill rod • Augers • Flights • Sampling tools

Other factors influencing the selection of decontamination procedures and schedules include:

- Consideration of the effect of various decontamination solutions on the equipment and sampling device materials(s). Before selecting a cleaning method for specific field equipment, consult the manufacturer's instructions to avoid the possibility of damage to instrument components. The FM is responsible for verifying that the decontamination method selected is appropriate for the contaminant present and the surface and/or material being decontaminated.
- A distinction should be made between requirements for decontamination in the field between sample locations and the requirements for decontamination prior to storage.

5.2.2 Chemical Contamination

Equipment that contacts known or suspected chemical contaminants is considered chemically contaminated. The item is typically released for unrestricted use if, after decontamination, it is free of visible contamination. If organic contamination is a concern, the equipment and/or sampling device will be scanned with appropriate instruments (e.g., Photo Ionization Detector or Flame Ionization Detector) before release in accordance with pre-defined site- or project-specific criteria. Refer to the SAP or other site- or project-specific plans for specific criteria for decontaminating chemically contaminated equipment and release requirements.

5.2.3 Radioactive Contamination

The method for decontamination of equipment and the exterior of sample containers that have been exposed to radioactive material is based on the material contaminated, the sample medium, the radiation levels, and the specific radionuclides to be removed.

Criteria for releasing decontaminated equipment for unrestricted use will be defined in site- or project-specific documents, typically the SAP. Release criteria shall be approved by the site/project Radiation Safety Officer.

Porous materials (e.g., wood, hollow concrete block, rubberized coatings, etc.) and equipment with surfaces inaccessible for a survey (e.g., electric motors, small diameter pipes, etc.) and items with surface coatings that could bind or cover the contamination are considered on a case-by-case basis and released by authorized personnel in accordance with SAP or other site- or project-specific criteria.

5.3 Precautions for Storage and Handling

5.3.1 Handling Practices and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Containers must be properly labeled with the contents. Safety Data Sheets must be available for solutions or solvents used or stored. Following are acceptable materials used for containing the specified cleaning solutions:

- Laboratory detergent must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
- Tap water may be kept in tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
- Deionized water must be stored in clean glass or plastic containers that can be closed when not in use. It can be applied from plastic squeeze bottles.
- Organic-free water must be stored in clean glass or Teflon® containers prior to use. It may be applied using Teflon® squeeze bottles.
- Solvents must be stored out of direct sunlight in the unopened original containers until used. They may be applied using Teflon® squeeze bottles.

Hand pump sprayers are generally not acceptable storage or application containers for the materials defined above (with the exception of tap water). This also applies to stainless steel sprayers. Hand sprayers typically have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

Solvents, laboratory detergent, and rinse water used to clean equipment shall not be reused during field decontamination.

5.3.2 Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigative derived waste, including wash water and rinse water, are in the EHS-46 “Management of Waste Generated at Project Sites” procedure. The SAP, and/or the project-specific Waste Management Plan may also include information for proper handling and disposal of these materials.

5.3.3 Handling Decontaminated Equipment

After decontamination, equipment shall be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment shall be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately reused it should be covered with plastic sheeting, wrapped in aluminum foil, or bagged to prevent re-contamination. The area where equipment is stored for reuse must be free of contaminants.

5.4 Pre-Sampling Requirements

5.4.1 Specifications for Designated Decontamination Area

Sufficient decontaminated equipment should be transported to the field so that daily work can be conducted without the need for field decontamination. When equipment must be decontaminated in the field, the following procedures are to be utilized for establishing a designated decontamination area.

The designated decontamination area shall be downwind of the location where clean equipment, clean sample devices, and samples containers are stored. This area shall also be in an area free of direct exposure to airborne and radiological surface contaminants.

Decontamination pads constructed for field cleaning of equipment should meet the following minimum requirements:

- The decontamination pad shall be constructed in an area known or believed to be free of surface contamination.
- The pad shall not leak. If the decontamination pad is found to be leaking at any time, the FM and PM shall be notified immediately.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. The sump or pit should also be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed. These sawhorses/racks should not be constructed of wood.
- Decontamination water shall be removed from the decontamination pad frequently.
- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be easily replaced (disposable) or repairable.
- At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material, but only after waste/rinse water has been pumped into containers for disposal. See EHS-46 “Management of Waste Generated at Project Sites”, the SAP, and/or the project-specific Waste Management Plan for proper handling and disposal of these materials.

On small projects, a decontamination pad may not be necessary. Where only “hand” sampling or other small equipment work is being conducted, several small washtubs may be sufficient for decontamination.

5.4.2 Preliminary Cleaning Requirements

Sampling equipment, including drill rigs, should be clean of contaminants that may have been transported from off-site to minimize the potential for cross-contamination. Sampling equipment brought on-site shall meet these minimum requirements:

- Downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination and sampling areas.
- Portion of the drilling equipment that are over the borehole (kelly bar, mast, buckets, platform, hoist, spindles, cathead, etc.) shall be steam cleaned and wire brushed to remove rust, soil, and other material that may have come from other areas before being brought on site.
- Painting and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove printing and/or writing. Most well material suppliers can provide materials without printing and/or writing if requested when ordered. Items that cannot be cleaned are not acceptable and should not be used.
- The drill rig and equipment associated with the drilling and sampling activities must be inspected to verify that oils, greases, hydraulic fluids, etc., on the surface of the equipment have been removed, and seals and gaskets are intact with no fluid leaks. This inspection must be documented (field logbook, inspection log, maintenance log, etc.).
- PVC or plastic materials shall be inspected. Reusable Items that cannot be cleaned are not acceptable and should not be used.

5.5 Drilling Equipment Decontamination

The following procedures are presented as a function of the level of contaminant concentration and are intended as general guidelines. Appropriate requirements should be established based on the individual site characteristics and type of investigation performed.

- Low to Moderate Contaminant Concentration
  - Steam or water rinse with tap water to remove mud or dirt.
  - Steam or hot water wash with a mixture of non-phosphate detergent and tap water or other type of decontamination solution.
  - Steam or hot water rinse with clean, tap water.
  - Air dry on a clean, plastic- or aluminum foil-lined surface.
- High Contaminant Concentration
  - Steam rinse with tap water to remove mud or dirt.
  - Rinse critical pieces of sampling or drilling equipment with an organic solvent and/or acid solution.
  - Steam wash with a mixture of non-phosphate detergent and tap water or other type of decontamination solution.
  - Steam rinse with clean, tap water.
  - Air dry on a clean, plastic- or aluminum-lined surface.

During decontamination of drilling equipment and accessories, clean the inside of hollow-stem auger flights, drill rods and drill bits (particularly roller bits), as well as couplings and threads. Generally, decontamination can be limited to the back portion of the drill rig and those parts that come in direct contact with samples or casing, or drilling equipment that is placed into or over the borehole.

Mud pumps, kelly, swivel, kelly hoses, and suction hoses on rotary drill rigs shall be cleaned by circulating a sufficient volume of clean water and cleaning solution through the system followed by a clean water rinse through the system.

Water or grout pumps may be sufficiently decontaminated by flushing with water. However, if a high concentration of contaminants or visible product is known to exist, then disassembly and thorough cleaning of internal parts is required prior to removal of the equipment from the site.

Some items of drilling equipment cannot typically be decontaminated. These include wood materials, porous hoses, etc. These items should not be removed from the site until they are ready for disposal in an appropriate manner.

5.6 Sampling Equipment Decontamination

Reusable sampling equipment, which may contribute to the potential contamination of a sample, must be thoroughly decontaminated prior to its initial use (unless specific documentation exists that the sampling equipment has been pre-cleaned or decontaminated) and between uses while actively sampling.

Generally, sampling equipment can be cleaned by hand. The following procedure is provided as a typical sequence that may be modified appropriately to be consistent with site conditions:

- Scrub with tap water to remove mud and residue.
- Scrub with a non-phosphate detergent/tap water solution or other decontamination solution as appropriate using a hard bristle brush.
- Rinse with clean tap water.
- Rinse with DI Water
- If required by the SAP, rinse equipment being used for sampling metals with an approved acid solution (e.g., 10% nitric acid) followed by another DI rinse.
- If required by the SAP, rinse equipment being used for sampling organic parameters with an approved organic solvent. Note: Do not solvent rinse PVC or plastic items.
- Air dry on a clean, plastic- or aluminum foil-lined surface.
- Package and seal equipment in plastic bags or other appropriate containers to prevent recontamination.

Use of high-pressure steam or hot water may be substituted for hand scrubbing if it effectively removes contaminants and soil and can be done safely without burning or contaminating personnel. Racks should be used to hold equipment while high-pressure washing.

Split-spoon, split-barrel, and Shelby tube samplers are commonly used to obtain soil samples. Most samplers contain a ball-check valve above the sample barrel that shall be thoroughly decontaminated prior to use/reuse.

Steel tapes, water probes, transducers, thermometers and water quality meters shall be rinsed in deionized water (demonstrated analyte-free) or cleaned in a non-phosphate detergent solution and rinsed once in deionized water after each use.

5.7 Well Materials Decontamination

Well-casing, regardless of material, must be cleaned thoroughly before installation. The well casing supplier should provide documentation of cleanliness. In lieu of supplier documentation, the following decontamination procedure will generally be used or adapted as appropriate for site conditions:

- High-pressure hot water steam wash with a non-phosphate detergent and tap water solution, organic or acid rinses (if appropriate) or other types of decontamination solution.
- High-pressure hot water or steam rinse with clean tap water.
- Air dry on a clean, plastic- or aluminum foil-lined surface or wipe dry.
- Wrap with plastic to prevent contamination before use.

5.8 Miscellaneous Equipment Decontamination

Step-by-step decontamination procedures for other typical sampling equipment are provided in Attachment 1. This information provided in Attachment 1 is not intended to be an exhaustive list of the type of equipment that may be utilized or that may require decontamination. Additionally, if site conditions or contaminants dictate a more specific decontamination procedure than those listed in Attachment 1, those alternate procedures shall be used. Alternate or additional decontamination procedure must be documented and approved by the Project Manager.

6. QUALITY ASSURANCE / QUALITY CONTROL

Effectiveness of the decontamination procedures is monitored by submitting rinse water to the laboratory for low-level analysis of the parameters of interest. The rinsate blank provides information on the effectiveness of the decontamination process in the field. When used in conjunction with the field blanks and trip blanks, a rinsate blank can detect contamination during sample handling, storage, and sample transportation to the laboratory. A rinsate blank consists of a sample of analyte-free (i.e., deionized) water which is passed over and through a field decontaminated sampling device and placed in a clean sample container. Rinsate blanks should be analyzed for parameters of interest at a rate a frequency appropriate for the project. Especially in the case of sampling events that occurred over multiple days or longer, the analytical results for the rinsate blanks should be evaluated as soon as possible to confirm that the decontamination procedure is effective. This frequency should be defined in the SAP.

In the event that rinsate blanks indicate a potential problem with the decontamination procedure, the quality of the DI and organic-free water used may be verified by collecting samples in standard, pre-cleaned sample containers and submitting them to the laboratory for analysis. Organic-free water should be submitted for low-level pesticide, herbicide, extractable, or purgeable compounds analyses, as appropriate.

Samples sent to a laboratory shall comply with E&E FTP-650 “Labeling, Packaging and Shipping Environmental Field Samples” and E&E FTP-625 “Sample Chain of Custody.”

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- E&E A17.1, Project Records Management
- E&E FTP-625, Sample Chain of Custody
- E&E FTP-650, Labeling, Packaging and Shipping Environmental Samples
- E&E FTP-1215, Field Activity Documentation
- EHS-46, Management of Waste Generated at Project Sites
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manualpdf.

9. ATTACHMENTS

- Attachment 1. Miscellaneous Equipment Decontamination

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a major revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information.
  - Section 5.2.3 – Removed reference to Attachment 1 and added Radiation Safety Officer responsibility.
  - Section 8 – Updated references.
  - Section 9 – Removed Attachment 1 from list.
  - Removed NRC Regulatory Guide 1.86 from the attachments since it has been withdrawn by the NRC.

ATTACHMENT 1

MISCELLANEOUS EQUIPMENT DECONTAMINATION

The following are guidelines for decontaminating typical equipment used for environmental field sampling. Not all sampling equipment is listed here. Additionally, if site conditions or contaminants dictate a more specific decontamination procedure than those listed here, those alternate procedures shall be used. Alternate decontamination procedure must be documented and approved by the Project Manager.

Well Sounders or Tapes

- Wash with laboratory detergent and tap water
- Rinse with tap water
- Rinse with DI Water
- Allow to air dry overnight (does not apply to field cleaning)
- Wrap equipment in aluminum foil with shiny side of the foil facing outward (with tab for easy removal), seal in plastic, and date.

Submersible Pumps and Hoses Used to Purge Ground Water Wells

This method applies whether this equipment is decontaminated in the field or in the field equipment warehouse.

- Pump a sufficient amount of soapy water through the hose to flush out residual purge water.
- Using a brush, scrub exterior of contaminated hose and pump with soapy water.
- Rinse soap from exterior of the hose with tap water, then rinse again with DI water.
- Pump a sufficient amount of tap water (approximately one gallon) through the hose to flush out the soapy water.
- Pump a sufficient amount of DI Water through the hose to flush out the tap water and then purge the pump in reverse mode.
- Rinse the outside of the pump housing and hose with DI Water (approximately ¼ gallon).
- Equipment will be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit. Ensure that a set of rotors, fuses, and cables are attached to each cleaned pump.

Engines for Portable Power Augers such as the Little Beaver

- The engine and power head will be cleaned with a power washer, steam jenny, or hand washed with a brush using detergent. Detergent does not have to be a laboratory detergent, but it should not be a degreaser. Remove oil, grease, and hydraulic fluid from the exterior of the unit.
- Rinse thoroughly with tap water.

ISCO Flow Meters, Field Analytical Equipment, and other Field Instrumentation

- Before selecting a cleaning method for specific field instruments, consult the manufacturer's instructions to avoid the possibility of damage to instrument components.
- Wash exterior of sealed, watertight equipment (such as ISCO Flow Meters) with a mild detergent (such as liquid dishwashing detergent).
- Rinse with tap water.
- Interiors of such equipment may be wiped with a damp cloth if necessary.
- Flow measuring equipment such as weirs, staff gages, and velocity meters may be cleaned with tap water after use between measuring locations.
- Other field instrumentation should be wiped with a clean, damp cloth. pH meter probes, conductivity probes, DO meter probes, etc., will be rinsed with DI Water before storage.
- The desiccant in flow meters and other equipment will be checked and replaced if necessary each time the equipment is cleaned.

Ice Chests and Reusable Shipping Containers

- Wash with laboratory detergent (interior and exterior).
- Rinse with tap water
- Air dry before storage

Drill Rigs and Associated Equipment

No oils or grease will be used to lubricate drill stem threads or other drilling equipment that is used over the borehole or in the borehole without documented prior approval from the client. If drill stems tend to tighten during drilling, Teflon® string can be used on the drill stem threads.

Portions of the drill rig, backhoe, etc., that are over the borehole should be steam-cleaned (detergent and high-pressure hot water) between boreholes.

In addition, downhole drilling and associated equipment that will come in contact with the downhole equipment and sample medium will be cleaned and decontaminated by the following methods:

- Clean with tap water and laboratory grade, phosphate-free detergent, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high-pressure hot water with detergent) may be necessary to remove matter that is difficult to remove with a brush. Auger flights and drill rods that are used to drill down in preparation for sample collection must be decontaminated thoroughly both on the outside and inside, as applicable. The steam cleaner and/or high-pressure hot water washer will be capable of generating at least 2500 psi of pressure and 200 degrees Fahrenheit or greater water temperatures.

- Rinse thoroughly with tap water. Tap water may be applied with a pump sprayer. Other decontamination liquids (DI Water, organic-free water, and solvents) must be applied with non-interfering containers. These containers will be made of glass, Teflon®, or stainless steel. This aspect of the decontamination procedures used by the driller will be inspected by the Field Manager and/or other responsible person prior to beginning of operations. Remove from the decontamination area and cover with clean, unused plastic (minimum 6 mil thickness). If stored overnight, the plastic should be secured so it stays in place.

Sample Container Exteriors

Decontamination of sample container exteriors must occur before placing the sample container in the sample cooler or shipping container.

- Wipe the exterior surfaces of the sample container with disposable rags/towels or rinse with DI Water.
- After rinsing with DI Water, if applicable, dry the exterior of the sample container with disposable rags/towels.
- Visible dirt, droplets of liquid, or other extraneous materials must be removed.
- For containers used in controlled access areas, or where the sample media is difficult to remove (e.g., sludge), a more rigorous cleaning and/or radiation monitoring may be required. Refer to site- or project-specific plans for details.

Stainless Steel, Teflon®, or Metal Sampling Equipment (Trace Organic/Metal Samples)

The following procedure is for decontaminating stainless steel, Teflon®, or metal sampling equipment used to collect samples for trace organic compounds and/or metals analyses:

- Clean with tap water and laboratory detergent solution. Use phosphate-free detergent, such as Liquinox®, or equivalent. Use a brush to remove particulate matter and surface film.
- Rinse thoroughly with organic-free water.
- Rinse twice with solvent (pesticide-grade isopropanol).
- Allow to air dry for 24 hours, if possible.
- If it is not possible to air dry for 24 hours, then rinse twice with organic-free water and allow to air dry as long as possible.
- Wrap sampling equipment with aluminum foil (with shiny side facing outward). This is done to prevent contamination of sampling equipment during transport and storage.

Stainless Steel or Metal Sampling Equipment (Radioactive Samples)

- Clean with tap water and detergent solution. Use phosphate-free detergent, such as Liquinox® or equivalent. Use brush to remove particulate matter and surface film, as necessary.
- Rinse with tap water.

- Air dry before reuse, if possible.
- If not possible to air dry before reuse, rinse thoroughly with organic-free water and allow to dry for as long as possible before reuse.

Glass Sampling Equipment

The following describes the methods for decontaminating glass sampling equipment used to collect samples for trace organic compounds and/or metals analyses:

- Wash thoroughly with laboratory detergent and hot tap water using a brush to remove particulate matter or surface film.
- Rinse thoroughly with hot tap water.
- Rinse thoroughly with tap water.
- Rinse twice with an appropriate solvent and allow to air dry for at least 24 hours.
- Wrap with aluminum foil (with shiny side facing outward). This is to prevent contamination during storage and/or transport to the field.

Silastic Rubber Pump Tubing (used in Automatic Samplers and other Peristaltic Pumps)

New clean tubing must be used for each automatic sampler set-up. The silastic rubber pump tubing need not be replaced in peristaltic pumps where the sample does not contact the tubing or where the pump is being used for purging purposes (i.e., not being used to collect samples). New tubing (certified clean by the manufacturer or medical grade) may be used in lieu of cleaning. New tubing may be dedicated to a well or new tubing used for each sampling event or location.

- Flush tubing with hot tap water and phosphate-free laboratory detergent.
- Rinse tubing thoroughly with hot tap water.
- Rinse tubing with DI Water.

Teflon® Sample Tubing

Only new or dedicated Teflon® sample tubing, decontaminated as follows, may be used for collection of samples for organic compounds analyses:

- Teflon® tubing may be pre-cut in convenient lengths before cleaning to simplify handling.
- Rinse outside of tubing with an appropriate solvent.
- Flush interior of tubing with an appropriate solvent.
- Dry overnight using a drying oven, if applicable.
- Wrap tubing and cap ends with aluminum foil, or store in a plastic bag to prevent contamination during storage.

Polyvinyl Chloride (PVC) Sample Tubing

Only new PVC tubing shall be used and decontaminated as follows:

- Tubing will be stored in its original container and not removed from this container until needed.
- The tubing will be flushed immediately before use to remove residues from the manufacturing or extruding process.
- Discard tubing after use in sampling.

Stainless Steel Tubing

- Wash with laboratory detergent and water using a long, narrow, bottle brush. Use hot water, if available.
- Rinse thoroughly with tap water. Use hot water, if available.
- Rinse thoroughly with DI Water.
- Rinse twice with an appropriate solvent.
- Allow to air dry for 24 hours, if possible.
- If it is not possible to air dry for 24 hours, then rinse thoroughly with organic-free water and allow to dry for as long as possible.
- Wrap with aluminum foil (with the shiny side facing outward). This is done to prevent contamination of tubing during transport and storage.

Glass Tubing

Use only new glass tubing, decontaminated prior to use as follows:

- Rinse thoroughly with approved solvent.
- Air dry for at least 24 hours.
- Wrap with aluminum foil (with the shiny side facing outward) to prevent contamination during transport and storage.

Leidos Proprietary

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Soil Sampling

E&E FTP-525, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

TABLE OF CONTENTS

1. PURPOSE

This Standard Operating Procedure (SOP) establishes methods for obtaining soil, or sediment samples for chemical and/or physical analysis to evaluate surface and subsurface conditions.

1.1 Scope and Limitations

This procedure applies to samples collected from soil or similar matrices using a spade, scoop, or hand auger by Leidos Energy & Environmental (E&E) Division personnel or subcontractors. Techniques are also included that cover collection of samples from areas with standing water.

The methods described in this procedure provide a disturbed sample and apply to a wide variety of soil and sediment types ranging from gravel and sands to silts and clays. This procedure also provides general guidance on the use of other sample tools that may be employed to collect both soil and sediment samples.

The mention of trade names or commercial products in this procedure does not constitute an endorsement or recommendation for its exclusive use.

1.2 Regulations or Standards

The regulation(s) or standard(s) included below may not be a complete list of regulations or standards applicable to the activity described in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

- ASTM D1452 / D1452M-16, *Standard Practice for Soil Exploration and Sampling by Auger Borings*
- ASTM D6282 / D6282M-14, *Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations*

1.3 Definitions / Acronyms

Depth Interval – The defined zone from which a sample is collected. The depth interval must have a starting value, an ending value and be recorded with units. For example, 2.0 to 4.0 feet below ground surface.

Hand-Operated Auger – A small, lightweight, metal auger. Diameters typically range between 1 and 4 inches. Augers are normally used in conjunction with 2 to 4 foot long metal shafts (extensions) and T-handles.

Homogenization – The mixing or blending of a soil or sediment sample to provide uniform distribution of contaminants. Proper homogenization ensures that portions of the containerized samples are equal or identical in composition and representative of the total soil sample collected.

Motor-Operated Auger – A metal auger attached to a shaft and powered by an internal combustion or electric motor. Augers for sample collection purposes will generally be less than 8 inches in diameter.

Photoionization Detector (PID) – a portable field instrument used for screening soil and atmosphere for volatile organic contamination.

Sampling and Analysis Plan (SAP) – A plan that documents the procedural and analytical requirements for a project that involves the collection of samples to characterize potential areas of contamination. This may be a stand-alone plan or included as a section in one of the other site activity plans.

Sample – The representative portion of a targeted population. This may be an entire drill core that is described for logging purposes or a portion of a core that is collected and submitted for physical and chemical analyses.

Scoop – A shovel-like utensil, usually having a deep curved dish and a short handle.

Spade – A sturdy digging tool having a thick handle and a heavy blade that can be pressed into the ground with the foot.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.
- Verifying conformance with applicable Sampling and Analysis Plan(s) (SAPs).

Site Safety and Health Officer

- Providing guidance on health and safety requirements pertaining to the work.

Field Manager (FM)

- Verifying that personnel perform their assigned duties in accordance with this procedure when it is applicable.
- Verifying conformance with the SAP during fieldwork.
- Managing fieldwork.

Field Staff

- Collecting samples in accordance with this procedure.
- Communicating issues encountered with the FM / PM.

3. HEALTH AND SAFETY

Proper personal protective equipment shall be worn at all times when performing field work. Appropriate safety precautions shall be observed when collecting soil samples. Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment.

Refer to the site- or project-specific Health and Safety Plan for relevant health and safety requirements. Questions, comments or concerns should be directed to the Field Manager and/or Site Safety and Health Officer.

4. EQUIPMENT AND SUPPLIES

- Sampling Equipment
  - Augers (see ASTM D1452 / D1452M-16 for more information about available augers). Examples include:
    - Hand-operated
      - Spiral-type
      - Ship-type
    - Open tubular
      - Orchard-barrel
      - Open spiral
      - Closed spiral
    - Post hole
      - Clam shell
      - Iwan
    - Machine-operated
  - Spade
  - Scoop
  - PVC pipe (schedule 40 minimum thickness)
  - Disposable or Teflon® bailers
  - Rope, as applicable
- Sample Containers (new sample containers, appropriate for the matrix and analytical test)
- Field Logbooks/Forms (see E&E FTP-1215 "Field Activity Documentation")
- Chain of Custody Forms (see E&E FTP-625 "Sample Chain of Custody")
- Writing utensils (indelible ink, black preferred)
- Decontamination Supplies (see E&E FTP-400 "Equipment Decontamination")
- Personal Protective Equipment (Refer to the site- or project-specific Health and Safety Plan for relevant requirements.)

5. PROCEDURE

5.1 Overview

A variety of techniques and tools exist for collecting surface and subsurface samples of solid matrices like soils and sediments. These include using scoops, spades or other digging tools to collect surface samples and using augers or other tools to bore into the subsurface to expose the desired sampling interval. The following sections detail procedures to be used for this type of sampling. Deviations from the requirements specified in this procedure must be justified to and authorized by the Project Manager. Deviations must be sufficiently documented in the field logbook to allow recreation of the modified process. These procedures may be superseded by more stringent project specific requirements as described in the SAP or other project-specific document.

Sampling tools and equipment must be decontaminated and protected from sources of contamination prior to and between sampling, as specified in E&E FTP-400 “Equipment Decontamination”.

Auger coatings such as chrome, paint, or other materials, with the exception of Teflon®, must be removed prior to use to prevent sample contamination. Stainless steel is preferred.

Spades or scoops must be either stainless steel or Teflon®-coated. Spades with chrome or other materials shall not be used as these materials may contaminate the sample. As an exception, disposable scoops may be used, if appropriate, for specified media and analytical parameters, in accordance with the SAP.

Care must be employed to avoid cross-contamination between sampling intervals and locations. Sample collection activities must be planned so they progress from areas suspected of the least contamination to areas of the highest suspected contamination. Background or uncontaminated samples must be collected, handled, and stored separately from samples that appear to be highly contaminated. Decontaminated or new disposable sampling equipment and new, disposable gloves shall be used for each sample taken. New gloves must be donned just prior to sample collection.

5.1.1 Collection of Material for Volatile Organics Analysis

Samples to be analyzed for volatile organics must be collected in a manner that minimizes disturbance to the sample. Samples for volatile organic analysis must not be homogenized. The appropriate aliquot (sample interval) specified in the SAP must be identified immediately after removing the sample from the ground and collected directly from the sample tool if possible. The subsample should be collected using an appropriate SW-846 Method 5035 compatible technique. The method should be consulted for additional details. Appropriate sample collection techniques include the use of a coring device (e.g., a Terra Core® transfer tool or a cut-off syringe) and direct transfer to a suitably preserved VOA vial where applicable (sodium bisulfate solution or methanol); or the use of an EnCore® sampling/storage tool or another technique as specified in the SAP.

5.1.2 Sample Homogenization

Samples collected for the analysis of parameters other than volatile organics must be homogenized before being separated into the various sample containers so that a subsample representative of the desired interval is provided. Samples shall be manually homogenized using a decontaminated stainless steel spoon or scoop and a stainless steel bucket or bowl. A disposable scoop and pan may also be used. Care must be taken to ensure that the soil is mixed or blended thoroughly to ensure the sample has a uniform distribution of contaminants.

5.2 Sample Collection

The following steps are applicable to all sampling techniques:

1. Don new gloves and use a stainless steel spade, or other approved utensil to remove surface vegetation and debris from the immediate area around the sampling point

2. Place plastic sheeting around the work area, as necessary, to prevent equipment from coming in contact with potentially contaminated surfaces and to prevent the transfer of contaminated materials to uncontaminated areas.
3. Record the appropriate information and observations about the sample location in the field logbook. See E&E FTP-1215 “Field Activity Documentation” for details.
4. Select the appropriate soil sampling technique from the following sections and collect representative sample material.
5. Preserve, label and prepare the sample for shipment in accordance with E&E FTP-650 “Labeling, Packaging and Shipping Environmental Field Samples”. This step includes completing the field logbook entries and COC forms. Details are included in E&E FTP-625 “Sample Chain of Custody”.
6. After drilling and sampling activities have been completed, boreholes shall be abandoned according to procedures described in the SAP. Borehole abandonment shall be compliant with applicable state regulations. Excavated materials must be handled in accordance with the waste management plan.

5.2.1 Soil Sampling Using a Spade or Scoop

1. Don new gloves and use a decontaminated stainless steel spade to remove soil down to the required sample interval.
2. Use a separate decontaminated scoop to remove a thin layer, if necessary, of soil that may have been in contact with the spade used in step 1 and discard this material.
3. Use a separate decontaminated scoop to obtain the appropriate volume of sample and place it on new aluminum foil or in a decontaminated stainless steel bowl on a polyethylene sheet or other appropriate material to help control the sample material and prevent potential sources of cross-contamination.
4. If volatile organic compound analysis is required, immediately transfer required portions to the appropriate sample container, avoiding large rock or other organic materials (i.e., roots, twigs, insects, worms, etc.), unless otherwise specified in the SAP. The portion suspected of the highest volatile organic contamination should be selected.
5. Use the spade or scoop to remove and discard large rocks or other organic materials (i.e., roots, twigs, insects, worms, etc.) from the remaining sample material and homogenize thoroughly, in accordance with the SAP, to provide samples representative of the entire interval.
6. Fill additional sample containers as required using appropriate, decontaminated equipment.

5.2.2 Soil Sampling Using an Auger

The use of a hand auger is typically limited to depths of 6 feet below ground surface; it is also used to clear down to 6 feet prior to subsurface drilling. The use of a hand auger can be restricted in dense clay or rocky soils.

1. Don clean gloves and assemble a decontaminated auger, extension, and T-handle, as required.
2. Advance the auger into the soil until the auger bucket is full.
3. Withdraw the auger carefully from the boring.
4. If a sample is not desired from the first interval, remove the soil from the auger bucket, discard and repeat steps 2 – 4, as required, to reach the desired sample interval. If a sample is to be taken in the next interval, replace the auger bucket with a decontaminated one prior to advancing into the sample interval. A decontaminated auger bucket must be used for each sample interval required.
5. After filling the auger bucket from the desired sample interval, use a decontaminated stainless steel scoop or other approved utensil to remove soil from the bucket. Place the sample on new aluminum foil or in a decontaminated stainless steel bowl on a polyethylene sheet (or other appropriate material) to control the sample material and prevent potential sources of cross-contamination. Remove material starting approximately two to three inches below the top of the auger bucket. Discard the material above this point. Additionally, the outside layer of the sample core should be removed using a stainless steel knife to further eliminate possible sources of contamination.
6. If volatile organic compound analysis is required, immediately transfer required portions to the appropriate sample container, avoiding large rocks or other organic materials (i.e., roots, twigs, insects, worms, etc.), unless otherwise specified in the SAP. The sample interval suspected of the highest VOC contamination should be selected (as indicated via a PID detector or other field screening tool, or visual observation of staining, oily material, etc.)
7. Use the spade or scoop to remove and discard large rocks or other organic materials (i.e., roots, twigs, insects, worms, etc.) from the remaining sample material unless otherwise specified in the SAP and homogenize thoroughly, in accordance with the SAP, to provide samples representative of the entire interval.
8. Fill additional sample containers as required using appropriate, decontaminated equipment.

5.2.3 Soil/Sediment Sampling in Standing Water

The details below are intended for use when the collection of a soil or sediment sample while limiting contact with overlying surface water is required. The methods described herein may not fully prevent contact with surface water in all soil conditions (such as gravelly or rocky soil).

The methods described can be used for standing water depths ranging from several inches to 20+ feet. These methods can be conducted from a boat or other floating platform subject to appropriate risk approval and health & safety requirements.

1. Once the sample location is determined, install a section of decontaminated PVC pipe by hammering the upright pipe into the soil while keeping the pipe as close to vertical as possible. The PVC pipe should be of sufficient length so that the top of

the pipe will remain above the level of the standing water after installation and should be of sufficient diameter to allow for the insertion and free movement of the auger to be used for sampling. A block of untreated wood may be used between the top of the pipe and the hammer to prevent damage to the pipe. A length of rope may be attached to the mid-section of the PVC pipe to ease removal when sampling is completed.

2. The pipe should be advanced to a depth sufficient to allow the pipe to form a seal with the surrounding soil in order to minimize the infiltration of standing water.
3. Standing water remaining inside the PVC pipe should be removed prior to augering by using a new or decontaminated bailer. If water continues to infiltrate into the PVC pipe during bailing, reposition the pipe or advance it deeper until an appropriate seal is achieved.
4. Follow the steps detailed in Section 5.2.2 to collect the necessary sample. Care must be taken not to disturb the PVC pipe and the surrounding soil.
5. Remove the PVC pipe and abandon the borehole per Section 5.2, step 6 above.

5.2.4 Subsurface Soil Sampling

When soil samples are to be collected from depths greater than 6 feet below ground surface, soil samplers should be advanced using drilling equipment. For subsurface soil samples to be collected using direct push sampling, a licensed, qualified driller must be used. Direct push soil sampling consists of advancing a sampling device into subsurface soils by applying static pressure, impact, vibration, or any combination thereof, to the above ground portion of the sampler extensions until the sampling device has been advanced to the desired depth. The sampling device is recovered from the borehole and the sample extracted. The sampling device is cleaned and the procedure is repeated for the next desired interval. Sampling can be continuous for full depth borehole logging or incremental for specific interval sampling. Once the sample interval of interest is obtained, the sample is homogenized (after the collection of an aliquot for VOCs, if required) and placed into appropriate sample containers.

5.2.5 Composite Samples

Compositing is the process of physically combining and homogenizing two or more spatially discrete samples. The composite is treated as a single sample to provide for an average concentration over multiple sampling points. Composite sampling is typically conducted at the beginning of field activities to locate the general areas of contamination without having to analyze a large number of samples. Review E&E FTP-691 “Composite Procedures” for details.

6. QUALITY ASSURANCE / QUALITY CONTROL

Field sampling quality control generally includes the collection of field duplicate samples and equipment rinsate blanks at a frequency specified in the SAP. Refer to the SAP for project-specific details and requirements.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 "Project Records Management".

8. REFERENCES

- E&E A17.1, Project Records Management
- E&E FTP-400, Equipment Decontamination
- E&E FTP-625, Sample Chain of Custody
- E&E FTP-650, Labeling, Packaging and Shipping Environmental Samples
- E&E FTP-691, Composite Procedures
- E&E FTP-1215, Field Activity Documentation
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.1 – Updated to reference E&E Division.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information.
  - Section 8 – Updated references.

Leidos Proprietary

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Sample Chain of Custody

E&E FTP-625, Revision 1.1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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ATTACHMENT(S)

1. PURPOSE

This Standard Operating Procedure (SOP) establishes the processes necessary to maintain and document the chain of custody (COC) for samples from collection through final disposition. Proper custody control and documentation is essential to verify the integrity of the samples and associated data.

1.1 Scope and Limitations

This procedure applies to samples collected and custody transfers executed by the Leidos Energy & Environmental (E&E) Division. The receiving laboratory shall be responsible for tracking custody transfers that happen internally including final disposition.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions / Acronyms

Chain-of-Custody (COC) Form – A form used to document sample custody transfers from the time of collection through final disposition. A COC form may be identified by a unique number printed or entered on the form.

Custody Holder – The individual with custody of the sample. Initially this is the sampler.

Custody Seal – A narrow strip of adhesive backed paper used to indicate tampering.

Custody Transfer – The process of passing responsibility, control, and access to a sample from one individual to another.

FM – Field Manager. The Field Manager supervises personnel on a site, ensuring everyone on the team is performing their responsibilities in the field.

Package – Container used to store and ship individual samples. Typically, a cooler will be used when samples must be preserved with ice.

PM – Project/Program Manager. The project manager will be responsible for PM designated activities in this procedure. If a project manager is not defined, then the responsibilities shall be assumed by the program manager.

Sample – A representative portion of a population.

Sample Custody – A sample is considered to be under a specific person's custody if the following conditions are met:

a) The sample is in the person's actual possession, or
b) The sample is in view of the person in possession; or
c) The sample is secured by the person in possession so that tampering can be detected.

Sample Team – Group of samplers working together to collect samples for a defined project.

Sample Team Leader – Team member designated by the PM or FM as the individual with primary responsibility for the integrity of samples collected by the team.

Sampler – The individual that collects the sample. References to sampler in this document may refer to either an individual or a sampling team. If the reference is being interpreted as a team then a sampling team leader must be designated in the field notes. The sampling team leader shall assume designated sampler responsibilities.

Secure Area – A space with restricted access used to protect samples when custody is not maintained by either direct physical possession or line of sight.

QA/QC – Quality Assurance / Quality Control

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.
- Verifying conformance with applicable Sampling and Analysis Plan(s) (SAPs).

Field Manager (FM)

- Overall management of field activities including communicating the importance of sample custody procedures and verifying their implementation.

Sampler

- Initiating the COC record prior to transferring sample custody and properly executing the initial custody transfer.

3. HEALTH AND SAFETY

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Proper personal protective equipment shall be worn at all times when performing field work.

Questions, comments or concerns about health and safety requirements should be directed to the Field Manager and/or Site Safety and Health Officer.

4. EQUIPMENT AND SUPPLIES

- Chain of Custody (COC) Form – minimum requirements:
    - Unique field sample ID, traceable to the field notes that clearly identify the physical location of sample origin.
    - Date and time of sample collection.
    - Number and type of sample containers, including preservation.

  - Name of the sampler or sample team leader.
- Custody Seal – minimum requirements:
  - Narrow strip of adhesive backed paper used to indicate if tampering has occurred.
  - Must be signed and dated by the person affixing the seal immediately after it is applied.
- Writing Utensil –handwritten entries shall be made using indelible blue or black ink, with black ink preferred.

5. PROCEDURE

5.1 Overview

A chain of custody form is used to record sample custody transfers. The form must be completed in a manner that accomplishes the following:

- Sample possession must be traceable from the time that samples are collected through analysis and final disposition.
- All sample custody transfers must be recorded on a COC form while Leidos maintains custody.
- All entries must be legible. Zeroes shall be recorded with a slash (/) through them to distinguish from the letter o.
- All handwritten entries shall be made using indelible blue or black ink, black ink preferred.
- Dates and times shall be recorded using the format mm/dd/yy for the date and the military or 24-hour clock format for time entries.
- Erroneous entries may only be marked out using a single line in a manner that does not obliterate the original entry.
- All corrections or additions shall include:
  - the signature or initials of the person making the change,
  - the date of the change, and
  - any information necessary to support and/or explain the need for the change.

The COC record must be initiated and completed by the sampler as soon as practicable following sample collection and before the initial custody transfer. The completed COC must accompany the sample(s) as long as Leidos maintains custody. Each sample must be listed on the COC form with the following minimum information:

- A unique sample ID, traceable to the field logbook (see E&E FTP-1215 "Field Activity Documentation").
- Date and time of sample collection.
- Number and type of sample containers, including preservation.
- Name of the sampler.

If QC or split samples are provided to another laboratory or entity, a separate COC will be filled out. Neither COC shall contain information revealing that the samples were split in order to maintain the integrity of the QA process.

5.2 Details

Samples may be retained by the sampler, transferred directly to another person, or transferred to another person via a common carrier or courier. Custody seals and secured areas must be used, as appropriate, to maintain custody control.

- Custody Seals
  Custody seals verify the integrity of the custody chain. The presence and condition of custody seals shall be noted on the COC when custody is officially transferred to the receiving party.
  - Custody seals must be affixed in a manner such that tampering will be evident
  - They must be signed and dated by the individual with custody of the samples immediately following application.
  - A minimum of two custody seals must be applied to the package, such as a cooler, on opposing corners.
  - A custody seal should also be used on inner packaging.
- Secure Area
  Packages of samples must be moved to a secure area as soon as practicable when custody is not maintained by either direct physical possession or line of sight. Packages of samples left in secure areas must also be protected from tampering by using custody seals if someone other than the custody holder may access the secure area.

5.2.1 Retain Custody

The custody holder may retain possession of the samples. Custody will be maintained by one of the following methods:

- Keeping the samples in the custody holder's possession;
- Keeping the samples in the custody holder's line of sight; or,
- Securing the samples in a manner such that tampering can be detected and storing the packaged samples in a secure area as soon as practicable.
  - Samples must be packaged and preserved appropriately.
  - All samples must be listed on the COC and the original COC must remain with the samples. Required information must be included on the COC before the samples are left in the secure area. However, the "Relinquished by" or equivalent field should not be signed or dated.
  - A minimum of two custody seals must be affixed to the package of samples. Custody seals must be signed and dated, at the time of application, by the custody holder.

5.2.2 Transfer Custody

The signatures of the individuals relinquishing and accepting custody shall be entered on the COC record at the time of the custody transfer along with the date and time the transfer occurs. The number of custody transfers should be minimized.

Note that custody is not formally passed to a courier or common carrier during shipping. The custody transfer is completed at the shipping destination by the individual that breaks the custody seal and signs the COC as the recipient.

- Details of the initial custody transfer shall be recorded in the field logbook.
- The person relinquishing and accepting custody should check that samples listed on COC are present and intact at the time of the transfer and that the COC is complete and accurate.
- All samples must be packaged with adequate preservative and packing materials to safely transport samples.
- Shipping information must be recorded on the COC when a courier or common carrier is used. Shipping paperwork must be retained for project files and tracking information must be recorded in the field notes.
- A copy of the executed COC should be retained for the project records by the sampler.
- The original COC must accompany the samples and generally should be sealed in a watertight, plastic cover in the package with the samples. This practice must be followed when shipping by a courier or common carrier. A convenient method to accomplish this is to place the COC in a re-sealable bag and tape it to the inside of the package.
- Custody seals must be used when shipping samples by a courier or common carrier.
- The condition of custody seals must be noted on the COC prior to accepting custody.
- When shipping multiple packages, samples must be grouped and recorded on COC(s) in a manner that clearly indicates the contents of each individual package.

6. QUALITY ASSURANCE / QUALITY CONTROL

All COCs should be peer reviewed prior to the initial custody transfer whenever practicable. Any peer review conducted shall be recorded in the field logbook and/or noted on the Chain of Custody form.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- DoD Environmental Field Sampling Handbook, Revision 1, April 2013.
- E&E A17.1, Project Records Management
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

- Attachment 1. Chain of Custody (Example)

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 3 Mar 2014, is the original version of this procedure issued under Leidos.
- Revision 1, dated 4 Feb 2015, is the first revision of this procedure. Minor revisions included the following:
    - Changing the Operation name from Environment and Civil Infrastructure (ECI) to Environmental Science and Engineering (ESE).
    - Revised footer on cover page.
    - Section 1.1 – Updated reference to ESE Operation.
    - Section 8 – Updated references. Added statement regarding where current versions of ESE procedures are located.
    - Section 7 – Revised statement to match information in other ESE procedures.
    - General formatting changes to be consistent with other ESE procedures.
- Revision 1.1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
    - Updated organization name from ESE Operation to E&E Division.
    - Revised signature line titles for clarity/consistency.
    - Changed web addresses to reflect current location.
    - Editorial changes to be consistent with other procedures.
    - Section 1.2 - Added statement to implement required regulations/standards.
    - Section 3 – Included stop work authority information.
    - Section 5 – Reformatted using 3rd level headers.
    - Section 8 – Updated references.

ATTACHMENT 1

CHAIN OF CUSTODY (EXAMPLE)

leidos

Chain of Custody

Page ____ of ____

Cooler ____ of ____

Report To:		**Invoice To:** ☐ Same as Reporting	
Company Name:		Company Name:	
Attention:		Attention:	
Address:		Address:	
City:		City:	
State:		State:	
Zip:		Zip:	
Phone Number:		Phone Number:	
Email Address:		Email Address:	

Parameters / Methods

Project Details (Name, site ID, etc.)

Turn Around Time Needed

☐ 24 hours ☐ 48 hours ☐ 72 hours

☐ 5 days* ☐ 10 days* ☐ 15 days*

☐ 30 days* ☐ ________

☐ RUSH *business days

Lab ID	Sample Identification	Collection Date	Collection Time	Grab / Composite	Matrix	# of sample containers										Sample Comments

Preservation: **1**= Ice, **2**= HCl; **3**= H2SO4; **4**=HNO3; **5**=NaOH; **6**= Other (explain under sample comments)

*****Container:*** **A**=1L G, **B**=500ml G, **C**=250ml G, **D**=1L P, **E**=500ml P, **F**=250ml P, **O**=Other(explain under sample comments), **V**=VOA

**G - Glass; P - Plastic

Order Comments / Instructions:		Shipping Company and Tracking Number:	
1. Relinquished by: (Print name legibly and Sign)	Date/Time	1. Received by: (Print name legibly and Sign)	Date/Time:
2. Relinquished by: (Print name legibly and Sign)	Date/Time	2. Received by: (Print name legibly and Sign)	Date/Time:
3. Relinquished by: (Print name legibly and Sign)	Date/Time	3. Received by: (Print name legibly and Sign)	Date/Time:

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Labeling, Packaging, and Shipping Environmental Samples

E&E FTP-650, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

____

Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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1. PURPOSE

This Standard Operating Procedure (SOP) establishes the minimum requirements for sample classification, storage, packaging, handling and shipment of samples.

1.1 Scope and Limitations

This SOP only applies to environmental samples obtained by the Leidos Energy & Environmental (E&E) Division personnel and subcontractors. Additional requirements, outside this scope, apply if the material sampled is known or expected to present a hazard. A sample that meets the criteria for one of the nine classes of hazardous materials as defined by the Department of Transportation (DOT, 49 CFR) or is identified as a dangerous good as defined by the International Air Transport Association (IATA, Dangerous Goods Regulations manual) must be packaged and shipped per the applicable requirements. See E&E FTP-651 "Hazardous Materials/Dangerous Goods Shipping" for more information.

The mention of trade names or commercial products in this procedure does not constitute an endorsement or recommendation for its exclusive use.

1.2 Regulations or Standards

The regulation(s) or standard(s) included below may not be a complete list of regulations or standards applicable to the activity described in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

- Code of Federal Regulations, Title 49, Transportation (The DOT Materials of Trade regulation includes a specific exemption for environmental samples.)
- Dangerous Goods Regulations, International Air Transport Association (IATA), latest revision

1.3 Definitions/Acronyms

49 CFR – Title 49 of the Code of Federal Regulations containing the principle set of rules and regulations issued by the Department of Transportation.

DOT – Department of Transportation

Environmental Sample – A sample of material that is collected from an environmental source.

Hazardous Material – material that falls under one or more of DOT's nine classes of hazardous materials: 1) Explosives, 2) Gases, 3) Flammable Liquid and Combustible Liquid, 4) Flammable Solid, Spontaneously Combustible and Dangerous When Wet 5) Oxidizer and Organic Peroxide, 6) Poison (Toxic) and Poison Inhalation Hazard, 7) Radioactive, 8) Corrosive, 9) Miscellaneous.

IATA – International Air Transport Association

Limited Quantity (Radionuclides) – Limited quantity is defined by 49 CFR as the maximum amount of hazardous material for which there is a specific labeling or packaging exception. Specifically, it is a quantity of Class 7 (radioactive) material not exceeding the material's package limits specified in 49 CFR 173.425 and conforming with requirements specified in 49 CFR 173.421.

Materials of Trade – Materials of trade are hazardous materials that are carried on motor vehicles for at least one of the following purposes.

- To protect the health and safety of the motor vehicle operator or passengers (e.g., insect repellant, fire extinguishers).
- To support the operation or maintenance of motor vehicles/auxiliary equipment (e.g., engine starting fluid, gasoline, spare battery).
- Materials that must be carried by a private motor carrier to directly support a principal business that is not transportation (e.g., pest control, plumbing, painting).

Sampling and Analysis Plan (SAP) – A plan that documents the procedural and analytical requirements for a project that involves the collection of samples to characterize potential areas of contamination. This may be a stand-alone plan or included as a section in another site- or project-specific plan.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting applicable activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Communicating general and project-specific sample identification requirements to the Field Manager.
- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.

Site Safety and Health Officer

- Reviewing appropriate site- or project-specific documents and/or procedures to verify that proper labeling, packaging, and shipping requirements are defined.
- Providing guidance on health and safety requirements.
- Periodically reviewing labeling, packaging and shipping activities to verify compliance with requirements.

Field Manager

- Overall management of field activities related to sample identification and packaging.
- Communicating client or project specific requirements to the field staff.
- Verifying that the field staff has the necessary materials (e.g., sample labels, packing materials, etc.) to perform work.

Field Staff

- Labeling samples accurately.
- Packaging and handling samples properly to prevent breakage and/or cross-contamination.
- Performing assigned tasks in a safe and effective manner according to established operating procedures.
- Attending required training and understanding tasks assigned.
- Using required personal protective equipment.
- Reporting unsafe or questionable conditions to a supervisor.

3. HEALTH AND SAFETY

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Proper personal protective equipment shall be worn at all times when performing field work.

Refer to the site- or project-specific Health and Safety Plan for relevant health and safety requirements. Questions, comments or concerns should be directed to the Site Safety and Health Officer and/or and the Field Manager.

4. EQUIPMENT AND SUPPLIES

Equipment and supply requirements for environmental sample labeling, packaging and shipping may vary based on sample matrix and project requirements. The following list includes some of the more common requirements:

- Chain of Custody forms (see E&E FTP-625 “Sample Chain of Custody”)
- Custody seals
- Field logbook/forms (see E&E FTP-1215 “Field Activity Documentation”)
- Packaging Materials (required as-needed):
  - Ice chest/cooler
  - Plastic liners sufficient to provide secondary containment for liquids
  - Ice (dry or wet; if required as a preservative)
  - Material to pad sample containers (e.g., bubble wrap/bags, vermiculite)
  - Re-sealable food bags
  - Wide clear tape (i.e., packing tape)
  - Temperature blank (may be optional depending on project requirements)
- Sample Labels
- Writing Utensil –indelible blue or black ink, black ink preferred.

5. PROCEDURE

5.1 Overview

Classification of samples (e.g., environmental, hazardous, dangerous goods) shall be based on the suspected level of contaminant concentration, which determines subsequent packaging and labeling requirements, shipping procedures and handling of samples.

This procedure specifically covers the requirements for shipping environmental samples. Samples classified as hazardous or dangerous goods shall be shipped only by appropriately trained personnel and by means specified in DOT (49 CFR) or the IATA Dangerous Goods regulations as appropriate. Requirements for shipping hazardous and dangerous goods are specifically not covered in this procedure. If there is uncertainty as to the sample classification, the field staff must consult with the Field Manager, the Site Safety and Health Officer, and the Project Manager prior to shipping samples.

Typical requirements for labeling, packaging and shipping environmental samples are discussed below. If a client or project requires different methods, those methods shall be followed provided they are not less stringent than the requirements stated here.

Deviations from the requirements in this SOP shall be clearly documented in the SAP or other appropriate project-specific document.

5.2 Sample Classification

Samples may be classified as environmental if site conditions are known, and the sample does not meet the criteria for any of the nine hazard classes identified by DOT. If site conditions are not known, it is important to be conservative in the estimate of contaminant concentrations until data exists to support classifying samples as environmental.

Samples taken for the purpose of radiological characterization are considered environmental samples as long as the shipment does not exceed the limited quantity of radionuclides. If the shipment exceeds limited quantity for the radionuclides present, refer to 49 CFR 173 for details regarding shipping requirements.

5.3 Environmental Sample Labeling

Unique sample identification shall be assigned to each sample container. The identification scheme shall be defined in the SAP or other appropriate project-specific document. The identification scheme should be designed such that the site, sample location within the site, sample matrix, and sample type (i.e., environmental, duplicate, split, composite, etc.) can be ascertained from sample identification. Some projects may have specifically defined requirements for sample identification that must be followed.

The sample label, which should be waterproof or affixed so it is protected from damage, shall include the following information, at a minimum:

- Sample identification
- Time of collection (24-hour, four-digit)
- Date of collection (MMDDYY or MM/DD/YY)
- Location of sample
- Identity of the sampler
- Preservation used

Other information that may be appropriate on a label includes company information, company phone number, sample interval, media, analytical method name and number, and field preparation information (e.g., filtered). Information required on labels must be defined in the SAP.

5.4 Sample Storage

Samples shall be stored in a manner consistent with the requirements for sample preservation to maintain the quality of the sample. Samples preserved by cooling shall be stored so that an acceptable range of temperature is maintained for the duration of the holding time. The cooling process must be initiated immediately after sample collection in the field. Shipment to the laboratory should be completed as soon as possible and within holding time limits specified for the particular analyses. If temporary storage is necessary, samples shall remain in an area that has been designated as a sample storage area that must be locked and secured to maintain sample integrity and chain of custody requirements (see E&E FTP-625 “Sample Chain of Custody”). Samples subjected to temporary storage shall be checked periodically to confirm the appropriate holding temperature is being maintained. The holding temperature and periodic temperature measurements shall be recorded in the field logbook or field form (see E&E FTP-1215 “Field Activity Documentation”).

Samples shall not be stored in refrigerators, coolers, or other areas where food or drink may also be stored and vice versa.

5.5 Environmental Sample Packaging

5.5.1 Regulatory Considerations

Current DOT and IATA requirements shall be reviewed by the Field Manager prior to a sampling event to verify that samples are shipped appropriately depending upon matrix and expected type and concentration of contaminants.

5.5.2 Shipping Containers

All sample containers should be placed inside a strong, tight container capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. A metal or plastic cooler (ice chest) with a hard plastic liner withstands this test. Drainage holes present must be taped shut on the inside and outside of the cooler to prevent contents from escaping (e.g., broken containers, water from melted ice, etc.).

The shipping container should be marked “THIS END UP” on all four sides with arrows indicating the proper upward position of the container.

Two plastic liners should be placed inside the shipping container and samples and ice (if required) shall be placed inside these liners.

The chain(s) of custody and other appropriate paperwork shall be sealed in a plastic bag and taped to the inside lid of the shipping container. Custody seals shall also be used, as appropriate, and in accordance with the requirements in E&E FTP-625 “Sample Chain of Custody”.

The shipping container should be taped shut to form a seal around the lid to prevent leakage in the event the cooler is turned over. Strapping tape should also be wrapped around the container in two locations if shipping via commercial carrier.

To prevent cross-contamination, shipping containers must be adequately cleaned between shipments with soap (preferably laboratory grade/specialty soap such as Alconox® or Liquinox® and water, unless stronger cleaner is required.

5.5.3 Ice

Samples requiring cooling are typically packed in loose or bagged wet ice, inside the cooler liner. Other methods of cooling the samples with ice may be used as long as the requirements are clearly defined in the SAP. The amount of ice used will depend on the available space in the cooler and the temperature requirements for the samples.

5.5.4 Glass Sample Bottles

The lid of the glass sample bottle shall be tightened to ensure an adequate seal and to prevent loosening during transit. If appropriate, lids should be sealed with tape or other secure fastening. Glass containers shall be wrapped and cushioned in an inert packing material such as vermiculite, closed-cell foam packing material, or bubble wrap. Samples containers should be placed upright in the shipping container and they should not be stacked.

5.5.5 Plastic Containers

Plastic containers do not require individual cushioning material, but must be packed to prevent movement during transit. Caps should be adequately tightened to prevent loosening. If appropriate, caps should be sealed with tape or other secure fastening. Samples containers should be placed upright in the shipping container and they should not be stacked.

5.6 Shipping Environmental Samples

Environmental samples may be shipped by commercial common carrier, vehicle, or air-cargo service to the laboratory. Commercial carriers should be contacted prior to packaging samples to ascertain specific restrictions, such as weight limits, as well as delivery and pick up schedules and/or receiving hours.

Preserved samples shall be received by the laboratory within the prescribed holding times.

6. QUALITY ASSURANCE / QUALITY CONTROL

Care must be taken at all times to ensure preservation requirements are maintained for samples, if needed, and that analytical hold times are being monitored.

Chain of custody forms should be verified with the contents of a shipping container prior to shipment by the field staff that will close and seal the container.

7. RECORDS

Documentation generated as a result of this procedure is submitted to the designated record system in accordance with E&E A17.1 "Project Records Management."

8. REFERENCES

- E&E A17.1, Project Records Management
- E&E FTP-625, Sample Chain of Custody
- E&E FTP-651, Hazardous Materials/Dangerous Goods Shipping
- E&E FTP-1215, Field Activity Documentation
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.1 – Updated to reference E&E Division.
  - Section 3 – Included stop work authority information.
  - Section 8 – Updated references.

Leidos Proprietary

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Hazardous Materials/ Dangerous Goods Shipping

E&E FTP-651, Revision 1

Effective 31 Dec 2020

Approved By: ______________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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1. PURPOSE

This Standard Operating Procedure (SOP) provides general information about packaging, marking, labeling, and shipping hazardous materials in compliance with U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) requirements. It will also provide information for the self-transportation of hazardous materials meeting the material of trade exception.

1.1 Scope and Limitations

This is a Leidos Energy & Environmental (E&E) Division procedure that applies all personnel involved in the offering or preparation of regulated hazardous materials/dangerous goods (HM/DG) for shipment (in non-bulk packaging) in accordance with Title 49 Code of Federal Regulations (CFR) Parts 171-177 or International Air Transport Association Dangerous Goods Regulations and self-transportation of hazardous material under the material of trade exception.

This procedure is meant to provide general information regarding HM/DG shipping, including transportation of MOT, and does not include specific instruction regarding requirements. Anyone preparing shipments of HM/DG, including MOT, should refer to the EHS-24 "Hazardous Material Transportation" procedure for more specific details.

This procedure does not qualify anyone to ship HM/DG. Specific training ranging from general awareness to highly-detailed training may be required. Contact your EH&S representative to determine what training is require prior to shipping any HM/DG. **Any need for an employee to engage in non-MOT HM/DG shipping must contact the Corporate EH&S Department prior to any shipping activity.**

The requirements for shipping in 49 CFR 171-177, the IATA Dangerous Goods Regulations, and/or the Leidos EHS-24 "Hazardous Material Transportation" procedure will always take precedence over the information in this procedure if any information conflicts.

1.2 Regulations or Standards

The regulation(s) or standard(s) included below may not be a complete list of regulations or standards applicable to the activity described in this SOP. It is the responsibility of the Project Manager to verify that applicable and current regulations and standards are implemented as necessary.

- Code of Federal Regulations, Title 49, Transportation, Hazardous Materials Regulations.
  - The DOT Materials of Trade regulation includes a specific exemption for environmental samples.
- International Air Transport Association (IATA), Dangerous Goods Regulations.
- Emergency Response Guidebook, Transport Canada, U.S. Department of Transportation, and Secretariat of Transport and Communications of Mexico.

1.3 Definitions/Acronyms

Dangerous Goods (Source-IATA) – Articles or substances which are capable of posing a significant risk to health, safety, property, or the environment when transported by air and which are classified according to Section 3 of IATA.

Environmental sample – A sample of soil, air, or water that may be contaminated. An environmental sample should not be shipped as a hazardous material or dangerous good unless it is known or expected to present a hazard as specified in one of the nine DOT hazard classes. Preservation of a water sample, with nitric acid, sulfuric acid, hydrochloric acid or sodium hydroxide, by an EPA method, does not make the sample a hazardous material.

Excepted quantity (Source-IATA) – Small quantities of some dangerous goods can be shipped without using UN specification packaging. For example, a Packing group II corrosive can be shipped as an excepted quantity shipment if each inner package contains no more than 30 mL and the outer package holds no more than 500 mL total. The packaging must still meet performance tests, which can be conducted by the shipper (Note: In nearly all cases, the terms small quantity and excepted quantity are synonymous.)

Hazardous Material (Source-DOT) – A substance or material, including a hazardous substance, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated.

Hazardous Material Employee (Source-DOT) – A hazardous material (hazmat) employee means a person who is employed by a hazmat employer and who, in the course of employment, directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle who transports hazardous materials in commerce. This term includes an individual, including a self-employed individual, employed by a hazmat employer who, during the course of employment:

- Loads, unloads, or handles hazardous materials;
- Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packaging's as qualified for use in the transportation of hazardous materials;
- Prepares hazardous materials for transportation;
- Is responsible for safety of transporting hazardous materials; or
- Operates a vehicle used to transport hazardous materials.

Limited quantity exception (Source-DOT and IATA) – When specified as such in a section applicable to a particular material, means the maximum amount of a hazardous material for which there is a specific packaging exception.

Materials of Trade exception (Source-DOT) – Materials of Trade means a hazardous material, other than a hazardous waste, that is carried on a motor vehicle in direct support of our work. This would include limited quantities of hazardous materials like pre-preserved sample containers, calibration gases, decontamination chemicals and other hazardous material that are used in our work. When carrying these limited quantities of hazardous materials Leidos has reduced requirements under DOT and is not required to carry a bill of lading or placard the vehicle. Packaging requirements and labeling are reduced from those required for shipping. Specific regulatory requirements may vary depending upon the material involved and the mode of transportation. EHS-24, “Hazardous Material Transportation” contains more information, including a checklist, to assist in program implementation.

Small quantity exception (Source-DOT) – Allows small quantities of certain hazardous materials (Class 3, Division 4.1, Division 4.2, Division 4.3, Division 5.1 and 5.2, Division 6.1, Class 7, Class 8, and Class 9) to be shipped without having to comply with full Hazardous Materials Regulations.

Hazardous Classes – Hazard class means the category of hazard assigned to a hazardous material under the definitional criteria of part 40 CFR 173 and the provisions of the 40 CFR 172.101 table. A material may meet the defining criteria for more than one hazard class but is assigned to only one hazard class. The hazard classes are:

- Class 1 – Explosives
- Class 2 – Gases
- Class 3 – Flammable and Combustible Liquids
- Class 4 – Flammable Solids, Spontaneously Combustible, Dangerous When Wet
- Class 5 – Oxidizer and Organic Peroxide
- Class 6 – Poison (Toxic) and Poison Inhalation Hazard
- Class 7 – Radioactive Material
- Class 8 – Corrosive Material
- Class 9 – Miscellaneous Dangerous Substances

UN number – UN numbers or UN IDs are four-digit numbers that identify dangerous goods, hazardous substances and articles (such as explosives, flammable liquids, and toxic substances) in the framework of international transport. They are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting applicable activities and that training shall be documented. All personnel who perform work subject to this procedure must have successfully completed the required training defined in the EHS-24 “Hazardous Material Transportation” procedure and the training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Verifying that adequate resources are provided to facilitate compliance with this procedure and transportation regulations.
- Verifying that personnel who receive, prepare for shipment, operate vehicles carrying, or ship HM/DG have the required training and certifications and perform these tasks in compliance with this procedure and applicable regulations/standards.

- Verifying that personnel performing DOT- and/or IATA-regulated tasks complete any additional training required to safely ship HM/DG (i.e., DOT Hazardous Materials training, Dangerous Goods Regulations Training, Leidos DOT courses, etc.).
- Verifying that the proposed shipping company is contacted prior to shipment to verify that the anticipated shipping method (packaging, marking, labeling, and classification) meets their understanding of the current regulatory requirements and shipper-specific requirements.
- Verifying that incidents or accidents are reported to the Division Health and Safety Manager immediately.

Division Health and Safety Manager

- Verifying that the requirements of EHS-24 "Hazardous Material Transportation" are implemented appropriately.
- Providing guidance on DOT- and/or IATA-regulated tasks, as needed.
- Verify that security plans are developed, as required.
- Ensure training is appropriate and documented for personnel preparing HM/DG for shipment.

Field Manager

- Overall management of field activities related to HM/DG shipping and handling.
- Communicating client- or project-specific requirements to the field staff.
- Verifying that the field staff have the necessary materials (e.g., sample labels, packing materials, etc.) and training to perform work.

Field Staff

- Performing HM/DG receiving, preparation for shipment, and shipment in compliance with this procedure and applicable regulations.
- Performing only those shipping-related tasks for which they have been trained. Note: Violation of this procedure may result in discipline, discharge, or release from service.

Site Safety and Health Officer

- Providing guidance, in coordination with the Division Health and Safety Manager, on the implementation of shipping procedures in accordance with requirements.
- Coordinating DOT- and/or IATA-regulated tasks outside the scope of this procedure and elevating issues, as needed, to the Division Health and Safety Manager.

3. HEALTH AND SAFETY

EHS-24 "Hazardous Material Transportation" contains detailed information regarding the minimum health and safety requirements. Personnel involved in shipping HM/DG must refer to that procedure for specific health and safety details.

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment.

4. EQUIPMENT AND SUPPLIES

- Chain of custody forms (see E&E FTP-625 "Sample Chain of Custody")
- Custody seals
- Field logbook(s) (see E&E FTP-1215 "Field Activity Documentation")
- Packaging Materials (required as-needed and/or as specified in accordance with the HM/DG that will be packaged and shipped):
  - Ice chest/cooler
  - Plastic liners sufficient to provide secondary containment for liquids
  - Ice (dry or wet; if required as a preservative)
  - Material to pad sample containers (e.g., bubble wrap/bags, vermiculite)
  - Re-sealable food bags
  - Wide clear tape (i.e., packing tape)
- Sample Labels
- Writing Utensil –indelible ink, black ink preferred
- Shippers Declaration For Dangerous Goods by IATA
- Airbill from appropriate courier
- Labeling per DOT and IATA requirements

5. PROCEDURE

5.1 Overview

- All personnel who perform work subject to this procedure must have successfully completed the required training defined in the EHS-24 "Hazardous Material Transportation" procedure and the training shall be documented. Training requirements will vary dependent upon the shipped materials, quantities and transportation method. No Leidos employee shall perform any shipping activity without confirming that appropriate training is completed. Contact the Corporate EH&S Department to determine applicable training requirements.

- Shipping papers (called Shippers Declaration for Dangerous Goods by IATA) are required to accompany HM/DG shipments. When Leidos uses an approved commercial carrier (e.g., FedEx) the vendor-supplied HM/DG shipping paperwork meets this requirement if it is completed correctly.

- Markings and labels per DOT and IATA requirements must include specific types of information. Packages must be marked on the outer container with the proper shipping name, UN ID number, shipping authorization, and shipper's and consignee's name and address. Labeling includes the hazard class, cargo aircraft only (if appropriate), and "this end up" labels if inner containers hold liquid hazardous material. Multiple sides of the package must be marked. Such redundancy is necessary in case a label is lost or becomes illegible.

- Packaging must conform to the specifications for material and quantity-specific requirements of DOT or IATA. UN specification packaging must be indelibly marked with the appropriate specification numbers. Other packaging can be used if a shipment meets the requirements for certain exceptions or exemptions.

Excepted or exempted packaging is not required to meet UN specifications but must pass performance tests, specifically drop and stack tests, some of which can be conducted by the shipper or the provider of the shipping container.

- See the EHS-24 “Hazardous Material Transportation” for specific details about HM/DG shipping.

5.2 Security Planning

Security issues must be addressed in training and planning for personnel shipping HM/DG. Hazardous material (Hazmat) employees must receive at least security awareness training. Hazmat employees whose work is subject to a security plan must receive in-depth security training to cover the requirements of the applicable security plan. Security plans are required for employers who ship relatively high hazard materials or relatively large quantities of hazardous materials. See the EHS-24 “Hazardous Material Transportation” procedure for more specific information regarding Security Plan requirements.

Security plans and the associated in-depth training are beyond the scope of this procedure. General security precautions that should be followed by Leidos personnel include the following:

- Secure/lock hazardous materials so that they are not accessible to unauthorized persons;
- Inspect and inventory hazardous materials on a regular basis; and
- Do not allow personnel who have not had DOT/IATA training to participate in hazardous materials shipments.

Violation of this procedure, EHS-24, DOT requirements, and/or IATA requirements may result in discipline, discharge, or release from service.

5.3 Materials of Trade Exception

49 CFR 171.8 defines a material of trade as a hazardous material, other than a hazardous waste, that is carried on a motor vehicle for the purpose of protecting the health and safety of the motor vehicle operator or passengers, for supporting the operation or maintenance of a motor vehicle including auxiliary equipment, or in direct support of a principal business that is other than transportation by a motor vehicle.

The materials of trade (MOT) exceptions are defined in 49 CFR 173.6 which includes the type and amount of materials considered MOT, packaging requirements, hazard communication requirements, and gross weight requirements.

Personnel handling MOT will receive, at a minimum, the Leidos DOT/IATA training which includes topics on general awareness, safety, hazard controls, label and placard recognition, and function specific requirements for MOT.

5.4 Small Quantity / Excepted Quantity

The U.S. DOT hazardous materials shipping regulations contain exceptions for small quantities of certain hazardous materials when shipping by ground. 49 CFR 173.4

provides the complete list of small quantity excepted materials and the requirements for applicability (e.g., size/amount, packaging, markings).

6. QUALITY ASSURANCE / QUALITY CONTROL

Care must be taken at all times that preservation requirements are maintained for samples, if needed, and that analytical hold times are being monitored.

Chain of custody forms must be verified with the contents of a shipping container prior to shipment by the field staff that will close and seal the container. Review E&E FTP-625 “Sample Chain of Custody” for applicable requirements.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- E&E A17.1, Project Records Management
- E&E FTP-625, Sample Chain of Custody
- 625 FTP-1215, Field Activity Documentation
- EHS-24, Hazardous Material Transportation
- EHS-48, Stop Work Authority
- Code of Federal Regulations, Title 49, Transportation
- Dangerous Goods Regulations, International Air Transport Association (IATA), latest revision

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures and forms.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a major revision to the procedure. Revisions included the following:
    - Updated organization name from ESE Operation to E&E Division and removed references to the Engineering Solutions Group.
    - Revised signature line titles for clarity/consistency.
    - Changed web addresses to reflect current location.
    - Editorial changes to be consistent with other procedures.

- Section 1.2 – Added statement to implement required regulations/standards.
- Section 3 – Included stop work authority information.
- Section 5 – Complete rewrite of this section, including removing specific hazardous materials shipping examples. Referred the reader to the Leidos EHS-24 procedure for specific shipping requirements and details.
- Section 8 – Updated references.
- Section 9 – Removed attachments.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Analytical Method Selection for Environmental Samples

E&E FTP-655, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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1. PURPOSE

This Standard Operating Procedure (SOP) establishes guidance on the selection of appropriate methodology for the chemical analysis of environmental samples and presents the various factors that should be considered during this selection.

1.1 Scope and Limitations

This SOP applies to the Leidos Energy & Environmental (E&E) Division. The requirements in this SOP may be superseded in the event a client requires different methodologies or analytical protocols. Client-specific requirements must be documented clearly in the Sampling and Analysis Plan (SAP) or other project-specific document.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions/Acronyms

Data Quality Objectives (DQO) – Qualitative and quantitative statements derived from the DQO process that clarify study technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Quality Assurance Project Plan (QAPP) – a document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Sampling and Analysis Plan (SAP) – A plan that documents the procedural and analytical requirements for a project that involves the collection of samples to characterize potential areas of contamination. This may be a stand-alone plan or included as a section in another site- or project-specific plan.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting applicable activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Communicating general and project-specific sample analysis requirements to the Field Manager.

Field Manager

- Overall management of field activities related to sample collection for the appropriate chemical analysis.
- Communicate client- or project-specific requirements to the field staff.

Project Chemist

- Communicate with the selected analytical laboratories and serve as the principle point-of-contact between the analytical laboratory and the Project Manager.
- Reviews methods selected for appropriateness in meeting the established data quality objectives.
- Work with the Field Manager and the analytical laboratory to coordinate the collection of samples with the appropriate sample bottles and preservatives to meet the analytical method requirements.

3. HEALTH AND SAFETY

Not Applicable.

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

For most of the analytical parameters associated with the chemical analysis of environmental samples, there is generally more than one analytical method. This SOP presents various factors to be considered in method selection if project requirements do not specifically dictate methods to be used.

To select the most appropriate method for analysis, the following factors will be considered:

- physical state of sample;
- anticipated concentration of analytes;
- required detection limit;
- data quality objectives (DQOs);
- regulatory requirements;
- set up and equipment available at the analytical facility; and
- cost of analysis.

Selecting the appropriate method involves assessing the characteristics of each sample, the intended use of the data obtained from the analysis, and the limitations imposed by the analytical facility.

Analytical levels of support are selected based upon DQOs. The analytical levels may be defined as follows, or as otherwise specified in the project-specific documents:

- Level I – Field screening using portable instruments. Results are often not compound specific and not quantitative.
- Level II – Field analysis using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory on site. There is a wide range in the quality of data that can be generated. It depends on the use

of suitable calibration standards, reference materials, sample preparation equipment, and the training of the operator.

- Level III – Analyses performed in an analytical laboratory, primarily utilizing standard EPA-approved procedures. This level provides qualitative and quantitative analytical data but does not usually include the extent of validation and documentation required for Level IV.
- Level IV – Analyses are performed in an analytical laboratory following Contract Laboratory Program (CLP), Department of Defense (DoD) Quality Systems Manual (QSM), or other stringent protocols designed to meet the intent of the project, program, or contract. This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data.
- Level V – Analysis by nonstandard methods in an analytical laboratory. Method development or modification may be required for specific constituents or detection limits.

5.2 Analytical Methods

The analytical methods to be applied to the samples are selected during the development of the SAP or QAPP or may be determined by regulatory or client requirements.

Due to unexpected sample characteristics that become evident only when the sampling or analysis task is actually performed, an alternative analytical method may be required; however, a tentative analytical method selection is necessary for cost estimating purpose. This enables the laboratory to prepare for the analysis (e.g., ordering reagents, scheduling analyses, etc.) and to prepare the proper sample containers.

5.3 Assessing the Sample

The physical state of the sample has an impact on the methods to be selected. Possible phase characteristics include aqueous, oil or organic liquid, sludge or sediment, solid, groundwater, or multiphasic. For multiphase samples, more than one method may be required.

5.4 Analyte Concentration

The expected level of contamination impacts the analytical method selection.

- Estimate the expected concentration of the analytes of interest for each sample. This estimate is based upon knowledge of the area being sampled, previous data obtained for that area, and field screening results available.
- Also, consider anticipated components of the sample that may interfere with the analysis of the sample and, therefore, require the use of a special analytical method.

5.5 Detection Limit

When communicating with the lab, define the terms and requirements (method detection limit, limit of detection, reporting limit, practical quantitation limit, etc.)

- Determine the required analytical detection limit for the parameter of interest. This determination is based upon the intended use of the data, as well as the program under which the samples are analyzed.
- The required detection limit may be determined by the applicable regulatory level or the concentration at which a specific action will be taken.
- A method that achieves the lowest detection limit possible is considered for composite samples.
- Samples that require dilution due to high concentrations of compounds of interest or sample matrix interferences will increase the level of detection.

5.6 Data Quality Objectives (DQOs)

During the preparation of project plans DQOs are established based upon the intended use of the data, developed during project planning, and documented in the QAPP. The required data quality level impacts the analytical methods that may be used. For example, if the purpose of the analysis is to qualitatively determine the presence or absence of a compound or group of compounds, a simple screening method may be applied. If however, a particular compound needs to be quantified with a high degree of precision and accuracy, a more rigorous method must be selected.

5.7 Regulatory Requirements

Samples collected must be analyzed in accordance with applicable federal, state or agency-specific regulatory requirements. Such requirements may dictate the detection limits to be achieved or, more specifically, the analytical methods to be used.

5.8 Analytical Facility

The selection of the laboratory, and analytical methods, may be impacted by the certification or accreditation required. The Project Chemist must verify the certification or accreditation of the laboratory for the parameters of interest.

Laboratory personnel will advise on limitations and method preferences of the analytical facility. It should be noted that most laboratories have restrictions on the limit of radioactivity that they may receive. Guidance will be sought from the receiving laboratory prior to sampling and transporting samples.

5.9 Cost

If a choice still remains, after all other factors have been considered, select the most cost-effective method. All method selections must meet the objectives of the SAP.

6. QUALITY ASSURANCE / QUALITY CONTROL

Analytical chemistry methodologies have prescribed quality assurance/quality control requirements in the written methods.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- E&E A17.1, Project Records Management

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 8 – Updated references.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Field Measurement Procedures

E&E FTP-750, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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1. PURPOSE

This Standard Operating Procedure (SOP) establishes the general methodology to obtain the following field measurements: organic vapor, combustible gas, mercury vapor, pH, temperature, salinity, conductivity, turbidity, dissolved oxygen, oxidation-reduction potential and radiation.

1.1 Scope and Limitations

This procedure describes the use of various equipment types to obtain measurements in the field by Leidos Energy & Environmental (E&E) Division personnel and subcontractors. The information herein is meant to serve as a guide to instrument operations. It does not indicate that the information contained herein is the generally preferred method, the only method, or the only instrument type that may be used. Specific calibration, operation and maintenance requirements are defined by the manufacturer's operating instructions.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions/Acronyms

DO – Dissolved oxygen

ME – Membrane electrodes

ORP – Oxidation-reduction potential

Sampling and Analysis Plan (SAP) – A plan that documents the procedural and analytical requirements for a project that involves the collection of samples to characterize potential areas of contamination. This may be a stand-alone plan or included as a section in another site- or project-specific plan.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field measurement activities with the instruments discussed herein and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers

- Verifying appropriate equipment is selected for the work required.
- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.

Field Manager

- Verifying compliance with the Sampling and Analysis Plan (SAP).
- Verifying that personnel perform their assigned duties in accordance with this procedure, as applicable.

- Overall management of field activities.

Site Safety and Health Officer

- Providing guidance and answering questions about health and safety requirements.

Field Staff

- Operating equipment in accordance with this procedure and/or appropriate manufacturer instructions.

3. HEALTH AND SAFETY

Health and safety requirements can vary with regard to using any piece of equipment. Operating instructions should be reviewed before operating equipment. Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Proper personal protective equipment shall be worn at all times when performing field work.

Refer to the site- or project-specific Health and Safety Plan for relevant health and safety requirements before performing work. Health and safety questions, comments or concerns should be directed to the Site Safety and Health Officer and/or the Field Manager.

4. EQUIPMENT AND SUPPLIES

Equipment and supplies vary depending upon the analytical analysis and the type of field instrument used. Refer to the manufacturer's instructions for specific details regarding the equipment and supplies necessary to properly calibrate, operate, use and maintain the equipment.

The following describes some of the instrumentation that is commonly used in the collection of data discussed in this procedure; it is not meant to be a comprehensive or all-inclusive list of field instruments. The SAP or another project-specific document will provide the specific equipment list needed for the execution of the field measurements.

- Organic vapor detectors are used for volatile organic compound (VOC) detection, hydrocarbon detection, soil contamination measurement, to detect organic vapors in depressions or confined spaces, to screen drums or other containers for the presence of trapped vapors, and to assess an area for elevated levels of volatile organics. Instrumentation suitable for these determinations includes photoionization detector (PID), flame ionization detector (FID), and colorimetric gas detection tubes. Examples include Photovac FID Organic Vapor Analyzers (OVAs), RAE Systems detectors, and Draegar tubes.

- Combustible gas sensors are designed to measure combustible gas or vapor content in air and may be used by hazardous materials teams or for confined space entry. These devices range from simple Oxygen/Lower Explosive Limit (LEL) combustible gas monitors (which measure explosive limits) to multi-gas monitors (which measure compounds that are potentially toxic at levels below the sensitivity of the LEL sensors) for toxic environments. An example would be a MultiRAE Gas Detector.

- Mercury vapor analyzers are portable devices that detect mercury vapor concentrations at a single point in time. They utilize various detection techniques including gold film sensors, ultraviolet absorption, or atomic fluorescence.
- Water quality parameters including pH, oxidation-reduction potential (ORP), temperature, dissolved oxygen (DO), conductivity, turbidity, and salinity are determined via single or multiple parameter field devices with one or more sensors. These sensors may include a temperature sensor (resistance temperature detector), a glass electrode sensor that uses a potentiometric method to measure pH and ORP, multi-electrode conductivity sensors, a polarographic sensor or an optical sensor for DO, and an electronic nephelometer for turbidity. Common devices include multi-parameter YSI meter or In-Situ TROLL probes.
- Radiation survey equipment may include ionization chambers, proportional counters, Geiger-Mueller (GM) counters, and scintillation detectors.

Other types of equipment and supplies may be required during field activities utilizing the equipment discussed in this procedure. Typical items include sample containers, calibration solutions, decontamination supplies, waste containers, personal protective equipment, field logbooks and field forms. The SAP or other project-specific document will define the specific equipment and supplies required.

5. PROCEDURE

5.1 Overview

Any deviations from the guidance contained herein, SAP-specified protocols or manufacturer instructions for equipment use must be authorized by the Project Manager and/or the relevant Program Manager and documented on the appropriate field change form. Justification for the deviation must be clearly defined.

The manufacturer’s operating instructions for each instrument in use must be present on site for reference.

The procedure E&E A12.1 “Control of Measuring and Test Equipment” will be followed for identification, storage and calibration of instruments used, as applicable.

Each section below will serve as a guide to the operation for the instrument discussed in that section.

5.2 Field Measurements

The following steps are typical for any field instrument:

- Choose an instrument that is consistent with the investigation requirements. Refer to the Health and Safety Plan or the SAP for detection requirements that must be met, as well as for details regarding sampling intervals or locations.
- Inspect the instrumentation for damage. If damaged, replace or repair before use.

- Verify the calibration date is current and perform routine calibration checks per the manufacturer's instructions. Adjust calibration if required. If the calibration date of the instrument has passed, do not use the instrument.
- Document routine calibration activities (field logbook entry or separate calibration log). Information to be recorded includes:
  - Name of the person performing the routine calibration.
  - Name and number (serial number or other identifying number) of the instrument.
  - Concentration of calibration gas or solution.
  - Calibration standard information (vendor and lot number (if applicable).
  - Date and time of the calibration.
  - Instrument reading when exposed to calibration gas (if applicable).
  - Amount of adjustment (if any).
  - Post-adjustment instrument reading (if applicable).
- Operate the instrument per the manufacturer's instructions and perform the required measurements.
- Record measurements in field logbooks or field forms in accordance with E&E FTP-1215 "Project Records Management". Information to be recorded for field measurements includes:
  - Name of the person operating the instrument.
  - Name and number (serial number or other identifying number) of the instrument used, reading(s).
  - Date, time, and location of the measurement (e.g., headspace of sample A, 5 inches from top of auger at soil boring 4, breathing zone of driller, etc.).
  - Measurement details/readings obtained. The minimum units for measurements shall be defined in the SAP or other appropriate project-specific document.
  - If applicable, information recorded must be sufficient to demonstrate to a third party that worker exposures were less than the exposure limits or when overexposures were detected and corrected.
- Decontamination of instruments may be required. Decontamination requirements shall be in accordance with E&E FTP-400 "Equipment Decontamination" and specifically defined in the SAP or other appropriate project-specific document.
- Record equipment problems encountered or environmental factors that may influence false readings and notify the Field Manager.

Specific field instruments are discussed below. The typical steps identified above are applicable to all of these instruments. Deviations or additions to the typical steps are highlighted.

5.2.1 Organic Vapor Detectors

The requirements listed in paragraph 5.2 are applicable to organic vapor detectors with the following addition:

- If extremely high concentrations are encountered while using an organic vapor detector, verify that the instrument is still operating properly before continuing to use the instrument.

5.2.2 Combustible Gas Detectors

Combustible gas detectors will not indicate the combustible gas content in an inert gas background, furnace stack, or in other atmospheres with less than 16% oxygen. Combustible gas detectors should not be used where the oxygen concentration exceeds that of fresh air (i.e., oxygen enriched atmosphere) because the extra oxygen makes any combustible mix easier to ignite and, thus, more dangerous.

The requirements listed in paragraph 5.2 are applicable to combustible gas detectors with no changes.

5.2.3 Mercury Vapor Analyzer

The requirements listed in paragraph 5.2 are applicable to mercury vapor analyzers with no changes.

5.2.4 Water Quality Parameters

Parameters associated with water quality parameters (e.g., pH, temperature, salinity, conductivity, ORP, and turbidity) may be measured with one instrument that is capable of measuring multiple parameters or separate instruments if necessary. The requirements listed in paragraph 5.2 apply whether one instrument is used or separate instruments are used.

5.2.5 Dissolved Oxygen (DO) Meter

The use of the membrane electrodes (ME) probe method for field measurement of dissolved oxygen in a variety of ground, surface, and saline waters, as well as in domestic and industrial wastes may be as a single probe or as a combination water quality meter (section 5.2.4).

The most common ME instruments for determination of DO in water are dependent upon the rate of diffusion of molecular oxygen across a membrane and upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentration. Interfacial dynamics at the ME-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence must be constant.

Dissolved inorganic salts are a factor in the performance of DO probes. Reactive gases that pass through the ME probes may cause interference. Hydrogen sulfide will also interfere with ME probes under certain conditions.

ME probes are temperature sensitive. A temperature compensation factor is normally provided by the manufacturer.

The requirements listed in paragraph 5.2 are applicable to DO meters with the following additions:

- Calibration adjustments may be required if the sample temperature is significantly greater (greater than 10%) than the calibration temperature. Calibration may also be required if the DO readings show a distinct change in DO levels.
- Inspect the membrane before each use for air bubbles, oily film, and/or holes. If the membrane is defective, it must be replaced and a new membrane prepared (soaked in distilled water before calibration).
- When taking measurements, verify the ME stirring apparatus is working (if using a submersible stirrer). If an operator is stirring the ME probe manually, the probe must be stirred as directed by the manufacturer.
- Always keep the probe in water when not in use to prevent the membrane from dying out.

5.2.6 Radiation Survey Equipment

This section is limited to ionization chambers, proportional counters, Geiger-Mueller (GM) counters, and scintillation detectors. The information provided below should be considered supplementary to the instrument’s instruction manual.

Radiation survey instruments shall be portable, rugged, sensitive, simple in design and operation, reliable, and intrinsically safe for use in explosive atmospheres.

An ionization chamber consists of a gas-filled envelope (usually air at atmospheric pressure) with two electrodes at different electrical potential. Ionizing radiation entering the chamber produces ions that migrate toward the electrode because of the applied potential, producing a current. The current requires amplification to a measureable level before it can be recorded on a meter. These are high-range instruments (low sensitivity) and are used extensively for measuring high intensity beta, gamma, or x-radiation. If no audio indication is possible with the instrument, the operator must be constantly aware of the meter to determine radiation intensity. Ionization chambers do not record individual radiation particles but integrate all signals produced as an electric current to drive the meter. They should be calibrated to the type and intensity of radiation to be measured.

The proportional counter has a probe with an extremely thin window that allows alpha particles to enter, and so is used extensively for this type of radiation detection by adjusting instrument parameters to discriminate against beta and gamma radiation. The meter is read in counts per minute and usually has several sensitivity scales. It should be noted that because of the nature of alpha particles, it is important to hold the probe as close as possible to (though not in contact with) the surface being monitored. The window of the proportional counter is delicate in construction, requiring care when being used as a field instrument.

GM counters operate principally in the same manner as ionization chambers except that secondary electrons are formed allowing greater sensitivity. They are very sensitive and are commonly used to detect low-level gamma and/or beta radiation. Meters are read in counts per minute or milliroentgens/hour. The gas amplification process inherent to this type of detector allows a single beta particle or gamma photon to be detected. It should be noted that these devices are sensitive instruments and care should be taken not to exceed their maximum capacity to prevent damage to the GM tube.

Scintillation detectors depend upon light produced when ionizing radiation interacts with a media (solid crystal used in survey instruments). They are extremely sensitive instruments used to detect alpha, beta, or gamma radiation simply by choosing the correct crystal. Alpha particles are detected with a silver activated zinc sulfide screen, beta radiation with an anthracene crystal (covered with a thin metal foil to screen alpha particles), and gamma or x-rays with a sodium iodide crystal. The instrument can be calibrated in the same manner as for ion chambers and GM counters. The operator should keep in mind that in older models the detector might be damaged if directly exposed to light without first disconnecting the voltage.

The requirements listed in paragraph 5.2 are applicable to radiation survey instruments with the following addition:

- The selection of the appropriate instrument is based on the suspected contaminant radionuclide, the type of radiation emitted, and the efficiency of the instrument to detect radiation.

6. QUALITY ASSURANCE / QUALITY CONTROL

Measurements are useful only when they are made at the correct time and location, have sufficient accuracy and precision, and are repeatable and reproducible. If these conditions are met and the measurements are obtained and recorded appropriately, the data can be confidently used in various decision-making situations. Good quality and defendable measurements can only be achieved if properly calibrated instruments are used and the instruments themselves are used in the appropriate manner. Calibration requirements must be specified in the SAP or other appropriate project-specific document. E&E Division employees shall not operate any instrument that is not calibrated or is past its calibration date, nor shall any instrument be used if the employee is not trained on proper use of the instrument.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.

8. REFERENCES

- E&E A12.1, Control of Measuring and Test Equipment
- E&E A17.1, Project Records Management
- E&E FTP-400, Equipment Decontamination
- E&E FTP-1215, Field Activity Documentation
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

Not Applicable.

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.1 – Updated to reference E&E Division.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information
  - Section 8 – Updated references.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Field Activity Documentation

E&E FTP-1215, Revision 2

Effective 31 Dec 2020

Approved By: ______________________
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Kimberly C. Murphree, P.E.
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ATTACHMENT(S)

1. PURPOSE

This Standard Operating Procedure (SOP) establishes the minimum requirements for recording field activities in logbooks and field forms along with the initiation, tracking and disposition of those records.

1.1 Scope and Limitations

Documentation is required under this SOP for field activities, as defined in Section 1.3 below, performed or directed by the Leidos Energy & Environmental (E&E) Division. Work plans, Sampling and Analysis Plans, Health and Safety Plans, Quality Assurance Plans, or other client specifications may include additional requirements for documenting field activities that must also be followed. Requirements shall be at least as stringent as those herein, unless approval is obtained from the Division QA Manager for alternate requirements.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions / Acronyms

Electronic Record Archival System – System used to electronically archive field activity records.

Field Activities – Work performed by the E&E Division or its subcontractors outside of a standard office, warehouse, or laboratory environment. Examples include environmental sampling, installation and/or operation of systems or equipment on site, remediation or construction activities, or other work that poses physical hazards or regulatory risks.

Field Forms – A project-specific collection of forms. Field forms are not required to be bound; however, they must be maintained securely to prevent loss. Field forms serve a similar purpose to a field logbook in that field data is captured in real time, in a specific format, and relevant to the objectives of the investigation or site activity.

Field Project Planning and Readiness Review (FPPRR) database – A database (https://apps.prism.leidos.com/eiapps/fieldpprr) designed to compile and track information necessary to successfully plan and execute a field activity. The completed database record forms the basis for the Readiness Review and provides evidence for determining field project readiness.

Force Majeure – An extraordinary event or circumstance beyond the control of the responsible person, such as war, strike, riot, crime, flood, tornado, earthquake, or volcano, which prevents fulfillment of an obligation. Force Majeure is not intended to excuse negligence or other malfeasance, as where non-performance is caused by the usual and natural consequences of external forces (e.g., predicted rain stops an event).

FTP – Field Technical Procedure

Logbook – A bound book with sturdy cover used to create a permanent, real-time record of activities, conditions, significant events, observations, measurements, field equipment calibration data, and other similar information occurring or related to field activities. Pages shall be sequentially numbered prior to use. Logbooks shall provide adequate detail in order to recreate the field event if necessary.

Logbook Tracking/Management System – System used to track the possession and location of logbooks.

Physical Storage Location – Designated location, defined as an official storage location for logbooks when not in use. Locations can range from a centralized location in a given office to a decentralized location such as a file cabinet in a Project Manager's office.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field activities and that training shall be documented.

2.2 Responsibilities

Project and/or Program Managers (PMs)

- Communicating general and project specific field activity documentation requirements to the field staff.
- Ensuring that the field documentation meets the project technical needs, including the eventual importation of field data to contract-, project- or program-specific databases.
- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.
- Assigning responsibility for scanning and archiving field activity records in the timeframe required.
- Communicating requirements for record archival.
- Providing a process for QC review of field activity records within a reasonable period following the field activity consistent with Section 6 of this procedure.

Field Manager

- Implementing and overseeing use of this procedure during a field activity, including the use of a logbook tracking/management system.
- Support and verify that the field staff has the necessary logbooks and field forms for the field activity.
- Reinforcing general and project specific requirements for field activity documentation.
- Verify that field activity records are reviewed as required and maintained in an electronic system.

Field Staff

- Checking out required logbooks for the field activity from the designated logbook tracking/management system.
- Accurately and completely documenting field activities.
- Uploading copies of field notes to the designated electronic record archival system.

- Maintaining physical control of logbooks and/or field forms while under their care.
- Checking logbooks back into the designated logbook tracking/management system following a field activity.
- Returning the logbook and field forms to the designated physical storage location following a field activity.
- Performing assigned tasks in a safe and effective manner according to established operating procedures.
- Using required personal protective equipment.
- Reporting unsafe or questionable conditions to a supervisor.

QC Reviewer

- Conducting a thorough review of the logbook and field form records for the field activity in accordance with the requirements in Attachment 1.
- Documenting the review by initialing or signing each page reviewed along with the date reviewed.
- Communicating issues noted during the review to the appropriate person for resolution.
- Reviewing necessary corrections identified during the QC review.

3. HEALTH AND SAFETY

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment.

4. EQUIPMENT AND SUPPLIES

- *Logbooks* – minimum requirements:
  - Bound with sturdy cover.
  - Sequentially numbered pages. The pages must be numbered prior to use so that page removal will be apparent.
  - Waterproof or Rite in the Rain type paper is preferred.
- *Field Forms* – as applicable.
- *Writing utensil* – handwritten entries shall be made using indelible blue or black ink, with black ink preferred. Avoid felt tip pens and *do not use pencil*.
- *Electronic media* – electronic options may be utilized in lieu of hardcopy logbooks. However, their use must be evaluated and approved during the Readiness Review (see E&E A2.2 "Field Project Planning and Readiness Review") prior to implementation.

5. PROCEDURE

5.1 Overview

A logbook(s) will be initiated, checked out of the designated logbook tracking/management system and used to record a field activity as it occurs. Each logbook shall be project-specific, and if possible site-specific. Records (logbooks and field forms) shall be uploaded to the designated electronic record archival system as soon as practicable following each day's activities. Records shall undergo a QC review as described in Section 6.

5.2 Details

5.2.1 Logbook Initiation

The type of logbook(s) needed to record a field activity will be determined during project planning. The logbook(s) shall be obtained, recorded in the designated logbook tracking/management system and initiated with the following information.

- Outside front cover
  - Unique logbook number.
  - Optional, but highly recommended – client name, project name, site location, project number.
- Inside cover and/or first page(s)
  - Ownership information - Company name, office address, office phone number.
  - Printed name, signature and initials of each individual making an entry in the logbook.
  - Date initiated.
  - Optional/Recommended – Table of Contents

5.2.2 Field Forms

Field forms should be designed/designated during the project planning phase and approved for use by the PM. The field logbook shall include a daily inventory of forms used. Field forms must include the following information, at a minimum:

- Title
- Site/Project information
- Date
- Page numbers in the form of “Page x of y”, or similar, on each page
- Associated logbook number

5.2.3 Logbook and Field Form Entries

The logbook and associated field forms constitute the compiled and chronological written record of the field activities conducted. These records shall be detailed enough so that another similarly qualified person unfamiliar with the site could recreate the field activities as they occurred. Entries must be factual, detailed, objective, and unbiased. Entries must be legible and entered using indelible blue or black ink, with black ink preferred.

Keep in mind that logbooks and field forms are work products that belong to the client; therefore, only entries that are appropriate to share with the client or third parties should be included. A listing of applicable logbook entries is included as Attachment 1 to this procedure.

- The following items should NOT be included in logbook or field form entries.
  - Unsubstantiated opinions (best professional judgment may be necessary in some cases).
  - Editorializing.
  - Language that is derogatory or that would not be acceptable in front of the client or in a public forum.
  - Events not relevant to the field activity.

    - Speculation or unfounded assumptions without basis.

- The following words should be avoided unless absolutely necessary and appropriate.
    - Approve
    - Inspection*
    - Supervision*
    - Definitive words such as – final, any, all, none, full, every, will, or shall.
    - Words of promise such as – guarantee, warrant, certify, ensure, or insure.

*Inspect and supervise are potentially dangerous words. Court decisions have interpreted these words to mean superintend, oversee, control, manage, direct, restrict, regulate, govern, administer, and/or conduct.

5.2.4 Logbook and Field Form Disposition

Logbooks and field forms shall be returned to the originating office (unless otherwise specified by the PM or Field Manager) and checked back in to the designated logbook tracking/management system as soon as practicable following completion of the field activity. Copies of logbooks and associated field forms shall be uploaded to the designated electronic record archival system.

6. QUALITY ASSURANCE / QUALITY CONTROL

Logbooks and field forms are both subject to subpoena and are admissible as evidence in legal proceedings. As such, they may be subjected to cross-examination. Consequently, the integrity and completeness of field activity records are critical.

- All records (logbooks and field forms) must undergo a QC review and be uploaded to the designated electronic record archival system within 14 calendar days of the record creation unless an alternate schedule is approved in the FPPRR database for the field activity (see E&E A2.2 “Field Project Planning and Readiness Review”). The QC review will evaluate the accuracy, completeness, legibility, consistency, and clarity of the records.

- The QC Reviewer shall indicate acceptance of the logbook and field form entries by adding their initials or signature at the bottom of each page along with the date reviewed.

- If errors, omissions, or uncertainties are found, the QC Reviewer will resolve them with the person responsible for making the original entries prior to signing or initialing the logbook/field form(s). The QC Reviewer will verify that the appropriate corrections are made. If the original person making the entries is not available, then the issue will be resolved with the Field Manager or Project Manager.

    - All corrections or additions shall include the signature or initials of the person making the change along with the date of the change, and information necessary to support or explain the need for the correction.

    - Erroneous entries may only be marked out using a single line in a manner that does not obliterate the original entry.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 "Project Records Management".

8. REFERENCES

- DoD Environmental Field Sampling Handbook, Revision 1, April 2013.
- E&E A2.2, Field Project Planning and Readiness Review
- E&E A17.1, Project Records Management
- E&E FTP-1220, Documenting and Controlling Changes to Approved Work Plans
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa/ for the current version of E&E referenced procedures.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

- Attachment 1. Applicable Logbook Entries

10. DOCUMENT CHANGE RECORD

- Revision 0, dated March 3, 2014, is the original version of this procedure issued under Leidos.
- Revision 1, dated 4 Feb 2015, is the first revision of this procedure. Minor revisions included the following:
  - Changing the Operation name from Environment and Civil Infrastructure (ECI) to Environmental Science and Engineering (ESE).
  - Revised footer on cover page.
  - Section 1.3 – Removed acronyms HS and QA/QC from the list.
  - Section 8 – Updated references. Added statement regarding where current versions of procedures are located.
  - Section 7 – Revised statement to match information in other procedures.
  - General formatting changes to be consistent with other procedures.
- Revision 2, dated 31 Dec 2020, is a major revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.2 – Added statement to implement required regulations/standards.
  - Section 5 – Reformatted using 3rd level headers.
  - Section 8 – Updated references.
  - Clarifying information added to Attachment 1.

ATTACHMENT 1

APPLICABLE LOGBOOK ENTRIES

- All entries shall be made using indelible blue or black ink, with black ink preferred. *Do not use pencil.*
- All entries must be legible. Zeroes shall be recorded with a slash (/) through them to distinguish from the letter o.
- Each day of the field activity should start on a new page.
- Entries should be made in chronological order and introduced with a notation of the time.
- Each page used must be signed or initialed and dated by the person making the entry.
- Unused portions of logbook pages and completed logbooks will be indicated by drawing a single line across the unused area. This line will be noted with the signature or initials of the person making the entry and the date of the entry.
- All dates must include the year, month and day.
- All times must be recorded in 24-hour format (e.g., 1500 rather than 3:00 p.m.)
- Corrections shall be made by drawing a single line through the incorrect information in a manner that does not obliterate the original entry. The correction shall include the initials or signature of the person making the correction, the date of the correction, and information necessary to support or explain the need for the correction.
- Additions to original entries must include the initials or signature of the person making the addition, the date of the addition, and information necessary to support or explain the need for the addition.
- The following shall be recorded as applicable:
    - Date and time of arrival at the field site.
    - Time required for equipment set up and time sampling started.
    - Purpose of the site visit/field work.
    - Notation of governing documents (e.g. work plan, sampling and analysis plan, etc.)
    - Weather conditions, updated throughout the day as appropriate.
    - Names and affiliations of anyone present during the field activities (e.g., Jane Doe (Leidos), John Smith (XYZ Contractor)).
    - Site sketch or map and description with a north arrow and rough scale. It is permissible to use a site map (reduced if necessary) and permanently affix it in the field logbook. The sketch or map shall identify surrounding permanent features (i.e., streets, rivers, buildings, parks, businesses, etc.) in order to provide a clear understanding of general location.
    - Problems, delays or unusual circumstances including equipment issues along with resolutions.

- o Deviation(s) from the Sampling and Analysis Plan or other site-specific document governing the field activity, including the name(s) of personnel that authorized the deviation(s). See E&E FTP-1220 "Documenting and Controlling Changes to Approved Work Plans" for information regarding other required documentation.
- o Level of PPE being used.
- o Field testing equipment - model and serial number or other unique identifier.
- o Calibration standards – lot number and expiration date.
- o Calibration and maintenance information for each piece of field testing equipment or a reference to the logbook(s) where this information is recorded.
- o Field measurements including the time of the measurement and units.
- o Sample collection methods and observations.
- o Relevant conversations with others present (e.g. discussion with a client representative or landowner, member of public). Include names and affiliation when possible.
- o Log of photographs including approval to take photographs along with the time, date, and description of each photograph.
- o Samples
    - ▪ Location identification. This may include measurements and a description from permanent features to the sample point and/or coordinates. It is important to thoroughly describe sample source locations so that they can be accurately located for future sampling events.
    - ▪ Date and time of sample collection.
    - ▪ Sample information – matrix, grab, composite, etc.
    - ▪ Field sample preparation information such as filtering. In the case of filtering, describe how the sample was filtered, including the type (manufacturer, lot number, pore size, filter description) of filter used.
    - ▪ Type and number of sample containers filled and preservatives used. If sample containers are not pre-preserved, then the addition of chemical preservatives must be described.
    - ▪ Custody procedures, chain of custody numbers.
    - ▪ Packing and shipping procedures, including use of custody seals.
    - ▪ Courier or Common Carrier contact information and tracking number.
    - ▪ Laboratory contact information.
- o Equipment decontamination procedures.
- o Disposition of excess materials.
- o All personnel site departures during the day and the final departure time at the conclusion of the day's activities.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Documenting and Controlling Field Changes to Approved Work Plans

E&E FTP-1220, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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ATTACHMENTS

1. PURPOSE

This Standard Operating Procedure (SOP) establishes the method for documenting and controlling field changes to approved project plans.

1.1 Scope and Limitations

This procedure applies to Leidos Energy & Environmental (E&E) Division personnel and subcontractors involved in field efforts governed by an approved project plan. This procedure should be used and referenced within the project plan when no other process (e.g., client directed) for the documentation of field changes exists.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions / Acronyms

Field Change – For the purposes of this procedure, a field change is a planned deviation from a procedure or requirement established in an approved project plan. Examples of typical field changes include the following:

- A change in the number of samples to be collected.
- A change in sample depth, location, or interval.
- A change in method of sample collection.
- A clarification to conflicting or confusing work plan or procedural requirements.
- The discovery of unanticipated hazards or changes in site hazards, hazard monitoring, or hazard controls.

Field Change Request (FCR) – A form used to request and document signature approval of a field change.

Field Change Control Log – A log used to track the status of requested field changes.

Field Logbook – A bound book with sturdy cover used to create a permanent, real-time record of activities, conditions, significant events, observations, measurements, and other similar information occurring or related to field activities. Pages shall be sequentially numbered prior to use.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to performing applicable activities and that training shall be documented.

2.2 Responsibilities

Project Manager/Program Manager (PM)

- Verifying that personnel are trained to this procedure and understand the process to initiate an FCR.
- Initiating FCRs.

- Coordinating with the Contract Manager to verify changes are not out of scope.
- Coordinating with the Contract Manager to obtain agreement from the client for the field change.
- Notifying the Field Manager of approved FCRs.
- Verifying that a copy of the approved FCR and associated documentation are maintained as a project record and providing a copy to the Contract Manager.

Site Safety and Health Officer

- Reviewing and approving or rejecting, as appropriate, FCRs that affect the Health and Safety Plan, or which may affect the health and safety of an employee or subcontractor.

Contract Manager

- Assisting the PM to obtain agreement from the client regarding field changes.
- Assisting the PM to verify that requested changes are not out of scope.

Field Manager

- Identifying items that may require a field change and notifying the PM.
- Providing appropriate information to the PM for FCR initiation.
- Completing and maintaining the Field Change Control Log. (Note: This responsibility may be designated by the PM to someone other than the Field Manager.)
- Maintaining updated copies of FCRs with the Field Change Control Log. (Note: This responsibility may be designated by the PM to someone other than the Field Manager.)
- Notifying affected field personnel of approved FCRs.

Field Staff

- Identifying items that may require an FCR and notifying the Field Manager.
- Correctly implementing the change after the FCR is approved.

3. HEALTH AND SAFETY

FCRs that affect the Health and Safety Plan, or the health and safety of any Leidos employee or subcontractor, must be reviewed and approved by the Site Safety and Health Officer before changes are implemented.

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Questions regarding health and safety shall be addressed to the Site Safety and Health Officer and/or the Field Manager.

4. EQUIPMENT AND SUPPLIES

Not Applicable.

5. PROCEDURE

5.1 Overview

Signature approval (preferred) or other formal documentation of client approval of an FCR must be obtained before the FCR is implemented.

5.2 Completion of the FCR Form

An example of a FCR form is included in Attachment 1. It is recommended that the attached form be used for FCRs; however, it is not required. The following information is required on a FCR, regardless of the format used:

- FCR Number – number assigned to the change request. Numbers should identify the project and be sequential.
- Date Initiated – date the change was first requested.
- Project – name of the affected project.
- Contract Number – contract number under which the project operates.
- Requestor Identification – the name of the person requesting the change, organization, phone number and title. Requestor also signs the form.
- Baseline Identification – Identify which baseline(s) is/are affected (i.e., cost, scope, milestone, method).
- Affected Document – exact title, revision number, section number, etc., of the affected project plan or procedure.
- Description of Change – provide sufficient detail and information for the reviewer to determine exactly how the affected project plan or procedure will be changed.
- Justification – include reasons for the change request (e.g., reduction in cost, minimization of health and safety risks, etc.).
- Impact of Not Implementing the Request – provide information regarding the impact if the change is not approved.
- Participants Affected by Implementing Request – identify participants affected (e.g., field personnel, data users, subcontractors, etc.).
- Cost Estimate – include an estimate of cost effect if request is implemented.
- Signature of Estimator – person providing the cost estimate signs and dates the form and provides their phone number.
- Previous FCR Affected – Indicated whether a previous FCR is affected by the current FCR. If yes, provide the previous FCR number.
- Approval Signatures – The client PM, client QA Manager (if applicable), and the Leidos Site Safety and Health Officer (if applicable) shall sign and date the form if approved. Note that while signature approval is preferred, approval may be documented without signatures on the form as long as another formal method of documenting approval is obtained. Documentation used to indicate approval must be maintained with the FCR form.

5.3 FCR Processing

The following steps shall be followed to initiate and obtain approval for a FCR:

- The PM, or designee, completes the FCR form.
- The Field Manager, or designee, initiates an entry in the Field Change Control Log (example included in Attachment 2) by entering the FCR number, the date initiated, the status, the plan(s) or procedure(s) affected, and the name of the person making the request.
- A copy of the unapproved FCR is maintained with the Field Change Control Log.
- The PM discusses the requested change with appropriate members of the project team (e.g., quality assurance, contracts, health and safety, field staff, etc.) as appropriate. The PM may revise the FCR, if necessary, based on these discussions.
- If the FCR includes a change in the project Health and Safety Plan or has a potential effect on the field team (including subcontractors) the Site Safety and Health Officer must approve the FCR.
- The PM or Contract Manager notifies the client of the scope, justification, and impact of the request. The FCR form is sent to the client for approval.
- When the client approves the FCR and the form is signed (or other documentation is obtained to indicate client approval), the PM provides the approved FCR and associated documentation to the Field Manager (or designee). The PM, or designee, shall submit a copy of the completed FCR to the designated electronic record system in accordance with E&E A17.1 “Project Records Management”.
- The Field Manager, or designee, replaces the unapproved FCR originally maintained with the Field Change Control Log with the approved copy. The status and date of FCR approval is noted on the Field Change Control Log to indicate the field change is complete.
- At the first opportunity, the Field Manager or PM notifies affected personnel of the field change. This notification is documented in the field logbook (see E&E FTP-1215 “Field Activity Documentation” for field logbook requirements). If the FCR affects health and/or safety, the Site Safety and Health Officer includes notification of the changes in one or more site safety briefings.
- If the client does not approve the FCR, the Field Change Control Log will be updated to indicate the rejection of the FCR. Information provided by the client on why the FCR was rejected should be recorded.

6. QUALITY ASSURANCE / QUALITY CONTROL

Any deviation from the requirements of an approved project plan without an approved FCR, or prior to approval of an FCR, constitutes a nonconformance and shall be documented on a Nonconformance and Corrective Action Report (NCR). See E&E A16.1, “Nonconformance and Corrective Action” for details regarding initiating NCRs.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E A17.1 "Project Records Management".

8. REFERENCES

- ESE A16.1, Nonconformance and Corrective Action
- ESE A17.1, Project Records Management
- ESE FTP-1215, Field Activity Documentation
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

- Attachment 1. Field Change Request Form (Example)
- Attachment 2. Field Change Control Log (Example)

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
    - Updated organization name from ESE Operation to E&E Division.
    - Revised signature line titles for clarity/consistency.
    - Changed web addresses to reflect current location.
    - Editorial changes to be consistent with other procedures.
    - Section 1.2 – Added statement to implement required regulations/standards.
    - Section 3 – Included stop work authority information.
    - Section 8 – Updated references.

ATTACHMENT 1

FIELD CHANGE REQUEST FORM (EXAMPLE)

FIELD CHANGE REQUEST (FCR)					
FCR Number:			Date Initiated:		
Project:					
Contract Number (CRN):					
Requestor Name:			Organization:		
Phone Number:			Title/Project Role:		
Requestor Signature:					
Baselines Affected:	☐Cost ☐Scope ☐Milestone ☐Method of Accomplishment				
Document(s) Affected (full title, revision no., page, section):					
Description of Change:					
Justification:					
Impact of Not Implementing the Request:					
Participants Affected by Implementing the Request:					
Cost Estimate ($):					
Estimator Name:			Phone Number:		
Estimator Signature:					
Previous FCR Affected:	☐ Yes ☐ No	If yes, FCR number:			

APPROVAL SIGNATURES			
Client Project Manager:		Date:	
Client QA Manager (if applicable):		Date:	
Leidos Site Safety & Health Officer (if H&S related):		Date:	

ATTACHMENT 2

FIELD CHANGE CONTROL LOG (EXAMPLE)

Program:			
Project Name:		**Contract Number (CRN):**	
Project Manager Name:			

FCR Number	Date Initiated	Status[1]	Document Affected[2]	Requestor	Date FCR Approved

[1] Open, Canceled, Rejected, Approved, or other appropriate designation for status
[2] Include full title and revision number along with chapter, section, and/or page number information as appropriate.

ENERGY & ENVIRONMENTAL DIVISION

STANDARD OPERATING PROCEDURE

Field Demobilization Checklist for Investigative Derived Waste

E&E FTP-1225, Revision 1

Effective 31 Dec 2020

Approved By: ______________________________

Michael D. Simms, P.E.
E&E Division Manager

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Kimberly C. Murphree, P.E.
E&E Division Quality Assurance Manager

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ATTACHMENT(S)

1. PURPOSE

This Standard Operating Procedure (SOP) establishes the specific responsibilities and requirements for the use of the Field Demobilization Checklist for Investigative Derived Waste (IDW). This form shall be utilized when ending a field effort either as a final or temporary demobilization. This checklist will support requirements in the EHS-46 "Management of Waste Generated at Project Sites" procedure.

1.1 Scope and Limitations

This procedure applies to IDW generated during Leidos Energy & Environmental (E&E) Division field projects. Work plans, Sampling and Analysis Plans (SAPs), Quality Assurance Project Plans (QAPPs), Waste Management Plans (WMPs), or other client specifications may identify and include specific regulations or standards for documenting field demobilization activities that must also be followed. If information in this SOP conflicts with applicable federal, state, local and/or contractual/facility requirements, those requirements shall take precedence.

1.2 Regulations or Standards

Although no regulation(s) or standard(s) are included here, it does not mean that none may exist for the activity defined in this SOP. It is the responsibility of the Project Manager to verify that applicable regulations and standards are implemented as necessary.

1.3 Definitions / Acronyms

Demobilization – The activities associated with ending a field activity permanently or, in some cases, temporarily due to completion of a phase of an ongoing activity.

Investigative Derived Waste (IDW) – IDW is waste that is generated in an environmental investigation at a site that is potentially or actually contaminated with hazardous substances or petroleum products. In general, IDW covered by this procedure includes, but is not limited to, the following:

- Solid Wastes: Soil cuttings from borings and monitoring well installation; soils from sampling; sludge; and/or sediment from sampling.
- Liquid Wastes: Purge water from monitoring well development and groundwater sample collection; drilling fluids; solutions used to decontaminate personal protective equipment (PPE) or investigation related equipment; and/or calibration solutions.
- Disposable Equipment: Contaminated disposable PPE or investigation related equipment.

Personal Protective Equipment (PPE) – Specialized clothing or equipment worn by employees to minimize exposure to health and safety hazards.

Waste Management Plan (WMP) – Plan that addresses the collection and disposal of waste generated during field activities. Waste Management Plans should be reviewed by an authorized approver before waste is collected.

2. QUALIFICATIONS AND RESPONSIBILITIES

2.1 Qualifications

Staff shall be trained to this procedure prior to conducting field activities and that training shall be documented.

2.2 Responsibilities

Program Manager

- Verifying the Project Manager is aware of the requirements of this procedure and performs said requirements appropriately.
- Providing adequate resources to implement the WMP.

Project Manager (PM)

- Developing and implementing a site-specific plan for managing IDW that conforms to the requirements in EHS-46 "Management of Waste Generated at Project Sites".
- Reviewing and archiving the Field Demobilization Checklist.
- Verifying the retention of relevant memoranda and supporting data concerning waste management.
- Verifying that personnel performing the activity described herein are trained to this procedure as well as other applicable Federal, State or local requirements, and that the training is documented.

Site Safety and Health Officer

- Providing guidance on safe work practices when handling IDW.
- Reviewing the WMP, as appropriate.

Field Manager

- Managing wastes generated by Leidos during a field project. This includes verifying that:
  - Requirements concerning containerization, labeling, storage, and storage time limits as specified in the waste management plan are met, and
  - Subcontractors manage waste in compliance with the waste management plan.
- Completing the Field Demobilization Checklist for IDW.
- Submitting completed Field Demobilization Checklists to the Project Manager.

3. HEALTH AND SAFETY

Implement stop work authority (EHS-48) any time an activity potentially poses an uncontrolled risk to human health or the environment. Proper personal protective equipment shall be worn at all times when performing field work.

Refer to the site or project specific HSP for relevant health and safety requirements. Questions regarding health and safety components of IDW shall be addressed to the Site Safety and Health Officer and/or the Field Manager.

4. EQUIPMENT AND SUPPLIES

Various types of equipment may be required to properly manage project waste. The WMP or other appropriate project-specific plan should be referenced for specific details on required equipment and supplies.

5. PROCEDURE

5.1 Overview

The Project Manager and Field Manager will determine if mobilization will cover one continuous effort or be divided into distinct cycles. For projects consisting of one continuous effort, then the Field Demobilization Checklist for Investigative Derived Waste (Attachment 1) will be completed at the end of the cycle. If the project will require more than one cycle, then a Field Demobilization Checklist for Investigative Derived Waste will be completed at the end of each cycle. Completed checklists will be placed in the project files in accordance with E&E A17.1 “Project Records Management”.

The Field Demobilization Checklist for Investigative Derived Waste provided in Attachment 1 is an example and may be amended for specific project requirements, if necessary, as long as the information captured on an amended checklist is at least as detailed as the checklist in this SOP.

5.2 Completion of Demobilization Checklists

The Field Manager completes the Field Demobilization Checklist for Investigative Derived Waste at the end of a field cycle.

- All line items must be completed on the checklist.
- Items checked N/A (not applicable) must have a brief justification in the comments column of the checklist.
- The Field Manager must verify that items are answered appropriately for field demobilization. Inconsistencies must be corrected prior to leaving the site.
    - Changes to the checklist must be initialed by the person making the change. A date must be included along with an explanation to justify the change.

5.3 Disposition of Demobilization Checklists

Completed checklists shall be submitted by the Field Manager to the PM for review, approval, and retention. The PM must approve the checklist before demobilization is complete.

6. QUALITY ASSURANCE / QUALITY CONTROL

The Project Manager shall review Field Demobilization Checklist(s) for Investigative Derived Waste. The Project Manager shall indicate acceptance and approval by adding their signature and printing their name at the end of each checklist along with the date reviewed.

If errors, omissions, or uncertainties are identified during the review, the PM shall take immediate action to resolve the issues.

7. RECORDS

Records generated as a result of this procedure shall be submitted to the designated electronic record system in accordance with E&E 17.1 “Project Records Management”.

8. REFERENCES

- E&E A17.1, Project Records Management
- EHS-46, Management of Waste Generated at Project Sites
- EHS-48, Stop Work Authority

Refer to https://apps.prism.leidos.com/eiapps/qa for the current version of E&E referenced procedures.

Current Environmental Health and Safety (EHS) procedures are maintained at https://prism.leidos.com/command_media/command_media_folders/leidos_ehs_manual pdf.

9. ATTACHMENTS

- Attachment 1. Field Demobilization Checklist (Example)

10. DOCUMENT CHANGE RECORD

- Revision 0, dated 31 Jan 2015, is the original version of this procedure issued under Leidos.
- Revision 1, dated 31 Dec 2020, is a minor revision to the procedure. Revisions included the following:
  - Updated organization name from ESE Operation to E&E Division.
  - Revised signature line titles for clarity/consistency.
  - Changed web addresses to reflect current location.
  - Editorial changes to be consistent with other procedures.
  - Section 1.2 - Added statement to implement required regulations/standards.
  - Section 3 – Included stop work authority information.
  - Section 8 – Updated references.

ATTACHMENT 1

FIELD DEMOBILIZATION CHECKLIST FOR INVESTIGATIVE DERIVED WASTE (EXAMPLE)

Project Title:	
CRN*:	**Project No:**
Person Completing Checklist (printed name):	**Person Completing Checklist (Signature):**
Date Checklist Completed:	

*Contract Record Number

SECTION A

Action	Yes	No	N/A	Date Completed	Initials	Comments
1. Are there wastes known to be RCRA hazardous waste or contain TSCA-regulated substances? **Note:** *If no, skip to Section B. If yes, continue with Section A.*						
2. Have known regulated wastes been transferred to the client (with transfer documented) or properly disposed offsite? **Note:** *Regulated waste must be transferred to the client's custody within three days of collection.*						
3. If known project-generated regulated wastes have not been transferred to the client (with transfer documented) or properly disposed offsite, have steps been taken to disposition the waste? (Describe the steps in the Comments section)						

SECTION B

Action	Yes	No	N/A	Date Completed	Initials	Comments
4. Does waste remain on site? **Note:** *If no, skip to Section C. If yes, continue with Section B.*						
5. Does Leidos have an on-going responsibility for storage, management or maintenance of waste remaining on site?						
6. Have remaining wastes been characterized, or samples taken to provide characterization information?						

SECTION B (cont.)

Action	Yes	No	N/A	Date Completed	Initials	Comments
7. Have actions required to remove the wastes for disposition been determined?						
8. Has a Leidos point of contact for the waste been established?						
9. If a waste hauling subcontractor is required, have they been notified that wastes are ready for disposal?						
10. Are waste containers remaining on site properly labeled (e.g., container number, date of generation, site name, source, client name, description of waste, approximate volume of waste, and physical state)?						
11. If a waste storage area is required, does it have security and postings appropriate to the type(s) of waste (e.g., warning signs, emergency points of contact, spill procedures)?						
12. If required, has photographic documentation of the waste containers been made, or a diagram of the waste storage area been prepared?						
13. Are liquid wastes containerized in secondary containment and protected from the elements (e.g., freezing)?						
14. Do containers of liquid to be left outdoors have sufficient headspace to prevent bulging? **Note:** *General rule of thumb for waste water is the headspace should be approximately 10% of the container volume.*						
15. Has secondary containment been provided for liquid wastes remaining on site pending disposition? If no, state why such containment was not required.						
16. If secondary containment is required for liquid waste remaining on site, have arrangements been made to exclude or remove precipitation from the containment receptacle?						

SECTION B (cont.)

Action	Yes	No	N/A	Date Completed	Initials	Comments
17. If waste is to remain on site and Leidos has a responsibility for storage and maintenance, have arrangements been made for routine inspections? Has the volume and type of waste been recorded in the field logbook?						

SECTION C

Action	Yes	No	N/A	Date Completed	Initials	Comments
18. Has IDW and/or other project-generated waste been transferred to the control of the client?						
19. Has IDW or other project-generated waste been transported offsite for disposal, and disposal documented?						

SECTION D

Action	Yes	No	N/A	Date Completed	Initials	Comments
20. Have residual chemicals (e.g., calibration gas, alcohol, acids) been dispositioned to preclude or minimize returning those items to Leidos facilities?						
21. Have pre-preserved sample containers been returned to the laboratory? Were the containers returned appropriately (proper shipping, labeling, packaging requirements)?						
22. Have samples (e.g., environmental or geotechnical) been accounted for and a process put in place to assure they are not returned to Leidos property?						

Project Manager Approval

Printed Name:	Date:
Signature:	

B.2 – LABORATORY SOPs

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Eurofins CEI, Inc.

STANDARD OPERATING PROCEDURES

ECEI Method 406: ANALYSIS OF ASBESTOS IN SOIL SAMPLES BY POLARIZED LIGHT MICROSCOPY

"Preparation and Analysis of Soil Samples by Polarized Light Microscopy using California Air Resources Board Method 435 and Implementation Guidance Documents"

Eurofins CEI, Inc.
Method Number: ECEI 406
PLM SOIL SOP
Last Revision: N/A
Original: January 6, 2020

1.0 Scope and Application

1.1 This standard operating procedure is created for the analysis of soil samples for asbestos by Eurofins CEI, Inc. (ECEI) using polarized light microscopy (PLM) method based on California Air Resources Board Test Method 435 (CARB M435) with modification based upon the Test Method 435 Guidance Document and Appendixes (2017). It covers a procedure for: (1) sample receiving, (2) sample drying, (3) sample pulverization, (4) provide quantification of the concentration of asbestos in the sampled soil (dried), and (5) quality control.

1.2 This test method has an analytical sensitivity of 0.25% by area.

1.3 This procedure consists of eight parts: Soil sample receiving, sample drying, sample preparation, stereoscopic examination, PLM point count, calculation, reporting, and quality control.

2.0 Summary of Method

2.1 Samples are received by the laboratory, dried, and pulverized (if necessary). The pulverization shall achieve the specific particle size distribution (PSD) criterion recommended by the Guidance Document.

2.2 The dried and pulverized sample is analyzed by stereomicroscopy and PLM. Positive fiber identification shall be based on morphology and optical properties listed in M435 Table 3.

2.3 A total of 400 particles are counted over at least eight slide preparations containing representative sample powder mounted in the appropriate refractive index liquid.

2.4 In addition to standard QA procedures (e.g., microscope alignment, calibration of refractive index liquids, instrument contamination check), a minimum of 10% duplicate and 5% replicate analyses are required.

2.5 The final report shall include the client information, project information, the date of analysis, the name of the analyst, and the calculated results of each sample analysis.

3.0 Sample Receiving

3.1 Samples are received and logged for proper test type according to the ECEI QA Manual Section 7.4 “Process Requirements: Handling of Test Items”. Samples are received daily via courier, US Mail, hand delivery, or from other departments of ECEI. The items are opened in a negative airflow HEPA filtered acrylic hood, and prepared for login and distribution.

3.2 Procedures Specific Login and Distribution of Bulk Asbestos Samples:

3.2.1 Samples received in each sample lot are assigned a unique laboratory identification code and placed in a re-sealable plastic bag.

3.2.2 Information on each sample lot is to be recorded in the Bulk Asbestos Log Book kept available in the laboratory, on the chain of custody, and on the sample bag itself. This information will include the following:

3.2.2.1 Customer's name

3.2.2.2 Date of sample receipt,

3.2.2.3 Assigned project code

3.2.2.4 Total number of samples

3.2.2.5 Assigned laboratory identification numbers

3.2.2.6 The initials of the person making the above entries in the sample log book for each sample lot.

3.2.3 Criteria for sample rejection: In cases where incoming samples are rejected, clients are to be promptly notified. Reasons for rejection will be explained to the client and the client will be asked to resubmit the sample(s). Criteria for sample rejection are listed below:

3.2.3.1 Improperly packaged samples will not be accepted for analysis.

3.2.3.2 Sample containers that do not contain enough bulk material for accurate analysis should not be accepted.

3.2.3.3 Samples that are not properly identified with unique field identification numbers may not be accepted.

3.2.3.4 Samples that do not have the proper paperwork attached may not be accepted.

3.2.4 The samples are packaged in a leak proof plastic bag and delivered to the PLM Bulk Sample Distribution location in the laboratory.

3.2.5 The sample lot shall be accompanied by the customer's chain of custody record.

3.2.6 The sample lot shall be accompanied by the Laboratory Chain of Custody Record generated by the Login Department.

4.0 Equipment and Materials

4.1 The following equipment is necessary for the preparation of soil samples in the Bulk Preparation Laboratory:

4.1.1 Negative Air Flow Hood – capable of pulling an air velocity of 75ft per minute;

4.1.2 Drying oven (capable of drying at 110^{o}C);

4.1.3 Forceps;

4.1.4 No. 4 scalpel blade handle with a No. 20 scalpel blade;

4.1.5 47mm plastic self-locking disposable petri plates capable of withstanding a 70° Celsius temperature;

4.1.6 Wiley Mini-mill;

4.1.7 analytical Balance with sensitivity to four decimal places (0.0001 g);

4.1.8 sieves – meshes and standard sieve frames shall conform to ASTM specification E11;

4.1.9 Mechanical Sieve Shaker;

4.2 Equipment for the PLM analysis:

4.2.1 All equipment used in *ECEI Method 400: Bulk Analysis by PLM "Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy"* Section 6.2.1 to 6.2.2 is used for the analysis of soil samples.

4.3 Reagents

4.3.1 Refractive Index Liquids: 1.490 – 1.570, 1.590 – 1.720 in increments of 0.004;

4.3.2 Refractive Index Liquids for Dispersion Staining: High-dispersion series, 1.550, 1.605, 1.630;

4.3.3 Common Asbestos (chrysotile, amosite, and crocidolite) from the National Institute of Standards and Technology;

4.3.4 Uncommon Asbestos (tremolite, actinolite, and anthophyllite) from the National Institute of Standards and Technology

5.0 Sample Preparation

5.1 Dry Soil Sample

5.1.1 Use disposable metal pans for oven drying.

5.1.2 Label drying pans or place labeled tags in the pan for sample identification.

5.1.3 Transfer the sample into drying pans under a negative air hood equipped with a high-efficiency particulate air (HEPA) filter.

5.1.4 Remove and discard organic materials such as leaves, plant stems, roots, twigs, etc.

5.1.5 Dry each sample in an oven at 110 $\pm$ 5^{o}C until the weight is stable (typically overnight).

5.1.6 Record the drying temperature and drying time on the sample analytical bench sheet.

5.1.7 Cool samples under a negative air hood that uses a HEPA filter.

5.1.8 Place disposable items used for drying in plastic bags that can be sealed and marked for proper waste disposal.

5.1.9 Ultrasonically clean non-disposable items used (e.g., clips, forceps, etc.).

5.2 Pulverize Under a Hood

5.2.1 Place Wiley Mini-mill under a negative pressure hood equipped with HEPA filter.

5.2.2 Pulverize the sample using Wiley Mini-mill to achieve the following particle size distribution:

5.2.2.1 At least 98 percent of the pulverized material passes through the 250-micrometer (60) mesh sieve.

5.2.2.2 The 75- to 250-micrometer fraction (60 – 200 mesh) is between 40 to 50 percent of the total mass of the sample processed.

5.2.2.3 The less than 75-micrometer fraction is between 50 to 60 percent of the initial sample mass.

5.2.3 Alternatively, if the sample volume is small, a mortar and pestle can be used to pulverize the sample.

5.3 Blanks

5.3.1 Asbestos-free soil blanks should be added for each set of samples to check for contamination.

6.0 Stereoscopic Examination

6.1 The pulverized sample should be examined under stereoscope for the homogeneity of the sample.

6.2 If chunks of positive building material (e.g., TSI, transite, etc.) are present, the material should be separately analyzed and reported.

7.0 PLM Analysis

7.1 An aliquot of bulk sample is removed from the sample pile in a weighing boat or on a piece of weighing paper.

7.2 The aliquot is spread out on a glass slide. A drop of 1.550 refractive index solution is added to the aliquot. A cover slide is placed on top of the sample slide.

7.3 If during the identification phase other asbestiform fibers are suspected to be present in the sample (due to their morphology), then additional analyses shall be performed with the appropriate refractive index liquids. Report the percentages of each asbestiform and combine percentages to determine total asbestos concentrations.

7.4 Positive identification of asbestos requires the determination of the following optical properties:

7.4.1 Morphology (3 to 1 minimum aspect ratio);
7.4.2 Color and pleochroism;
7.4.3 Refractive indices;
7.4.4 Birefringence;
7.4.5 Extinction characteristics;
7.4.6 Sign of elongation.

7.5 Quantify asbestos content following a point-count procedure. An ocular reticle (Chalkley point array) or cross-hair is used to visually superimpose points on the microscope field of view. The point counting rules are as follows:

7.5.1 Record the number of points positioned directly above each particle or fiber.

7.5.2 Record only one point if two points are positioned over same particle or fiber.

7.5.3 Record the number of points positioned on the edge of a particle or fiber.

7.5.4 If an asbestos fiber and a matrix particle overlap so that a point is superimposed on their visual intersection, a point is scored for both categories.

7.5.5 If a test point lies over an ambiguous structure, no particle or fiber is recorded. Examples of "ambiguous" structures include: 1) fibers whose dispersion colors are difficult to see; 2) structures too small to categorize.

7.5.6 A fiber mat or bundle is counted as one point.

7.5.7 A total of 400 points superimposed on either asbestos fibers or non-asbestos matrix material must be counted over at least eight different preparations of representative subsamples. Take eight forceps samples (total of approximately 40 milligrams of powered material) and mount each separately with the appropriate refractive index liquid. The preparation should not be heavily over loaded. The sample should be uniformly dispersed to avoid overlapping particles and allow approximately 30 percent empty area within the fields of view. Count 50 nonempty points on each preparation.

7.5.8 Count multiples of 400 points (e.g., 800, 1200) if lower detection limit is required.

7.5.9 Quantification should be performed at 100X. However, to better assess the optical properties and morphology 200X or 400X magnification may be used for identification.

7.5.10 If the analyst observes a calibrated visual estimate of asbestos that ≥10%, analyst may discontinue the point count, and give a calibrated visual estimate for a final result.

8.0 Calculations

8.1 Total calculated asbestos content in the soil sample using PLM point count analysis is determined using:

Total Asbestos (%) = (a / n) x 100% …………… (1)

Where: a = number of asbestos points;
n = number of total non-empty points counted (400);

9.0 Reporting the Analytical Results

9.1 Report the following information for each soil sample analyzed as follows:

9.1.1 If a = 0 in equation (1), report “No asbestos detected”;
If a > 0 in equation (1), report the calculated value to the nearest 0.25%;
If a = 0, but asbestos fiber was observed during point count, report “0%” but include on the report the asbestos type detected.

9.1.2 Type(s) of asbestos present.

9.1.3 Customer Information

9.1.4 Project information

9.1.5 The date of analysis

9.1.6 The date of reporting

9.1.7 Analyst’s name and the signature of individual qualified to review the test report.

10.0 Quality Control / Quality Assurance

10.1 Perform 10% duplicate analysis of the samples.

10.2 Perform 5% replicate analysis of the samples.

10.3 The results of initial analysis and duplicate/replicate analysis should match (i.e., either both analyses detect asbestos greater than 0.25 percent concentration, or both result in $\leq$ 0.25 percent concentration).

10.4 Prepare and analyze one blank in every 50 samples.

10.5 Perform instrument contamination checks using fiberglass or other asbestos-free material every 20 samples.

10.6 Follow all pertinent ECEI quality assurance procedures which include analyst training, microscope alignment, calibration of refractive index liquids, and documentation.

11.0 Method Validation

11.1 This method was validated by California Environmental Protection Agency Air Resource Board in 1991 and re-validated by ECEI using a set of in-house performance evaluation (PE) samples.

11.2 Method reviewed and approved by:

ECEI Laboratory Director: ______________________________ ____________
Tianbao Bai, PhD, CIH **Date**

ECEI Quality Manager: ______________________________ ____________
Gary A. Swanson **Date**

11.3 Analysts/Technicians: All personnel involved with handling, receipt, preparation, reporting, and review of CARB M435 soil samples must follow this SOP Manual with regards to whatever involvement they have in the SOP procedures.

11.4 Employee Compliance Statement: I have read the *"Eurofins CEI, Inc. Standard Operations and Procedures: Method 405: ANALYSIS OF ASBESTOS IN SOIL SAMPLES BY POLARIZED LIGHT MICROSCOPY. "*I understand and will implement all portions of the SOP that apply to my authorized position".

Tianbao Bai Date

Gary A. Swanson Date

Candace Burrus Date

Megan Fisher Date

Greg Ruff Date

Samantha Card Date

Shilpa Ladekar Date

Saithya Painkal Date

Scott Minyard Date

Danielle Carrier Date

Additional:

Name Signature Date

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Appendix I

California Environmental Protection Agency

Air Resources Board

State of California
Air Resources Board

Method 435

Determination of Asbestos Content of Serpentine Aggregate

Adopted: June 6, 1991

Method 435

Determination of Asbestos Content of Serpentine Aggregate

1 PRINCIPLE AND APPLICABILITY

1.1 Principle.

Asbestos fibers may be released from serpentine rock formations and are determined by microscopic techniques. The results are very sensitive to sampling procedures. The analytical results are reported in percent asbestos fibers which is the percent number of asbestos fibers contained in 400 randomly chosen particles of a bulk sample. Since the homogeneity of the material is unknown, the uncertainty in the sampling cannot be defined. The uncertainty of the analytical technique is two percent if twenty asbestos fibers are counted in a sample of 400 particles. The derivation of this uncertainty value is explained in Section 7.4.

1.2 Applicability.

This method is applicable to determining asbestos content of serpentine aggregate in storage piles, on conveyor belts, and on surfaces such as roads, shoulders, and parking lots.

2 DEFINITIONS

2.1 Bulk Sample

A sample of bulk material.

2.2 Grab Sample

A sample taken from a volume of material.

2.3 Composite Sample

A mixture or blend of material from more than one grab sample.

2.4 Serpentine

Serpentinite, serpentine rock or serpentine material.

2.5 Executive Officer

The term Executive Officer as used in this method shall mean the Executive Officer of the Air Resources Board (ARB) or Air Pollution Control Officer/Executive Officer of a local air pollution control district/air quality management district.

3 APPLICABLE SOURCES

This method can be used to obtain bulk material samples from three types of sources:

1. Serpentine aggregate storage piles,

2. Serpentine aggregate conveyor belts

3. Serpentine aggregate covered surfaces.

4 SAMPLING APPARATUS

4.1 Serpentine Aggregate Storage Piles.

Tube insertion often provides the simplest method of aggregate material investigation and sampling. Insertion tubes shall be adequate to provide a relatively rapid continuous penetration force.

4.1.1 Thin-walled tubes should be manufactured as shown in Figure 1. The tube should have an outside diameter between 2 to 5 inches and be made of metal or plastic having adequate strength for penetration into aggregate piles. These tubes shall be clean and free of surface irregularities including projecting weld seams. Further information on these tubes can be found in Table 1 and ASTM D 1587-83, which is incorporated herein by reference.

4.1.2 The insertion tube can be made out of commercially available two inch PVC Schedule 40 pipe. Further information on the tube can be found in Table 2.

4.1.3 A round point shovel may be used.

4.2 Serpentine Aggregate Conveyor Belts.

4.2.1 Sampling of aggregate off a conveyor belt requires a hand trowel, a small brush, and a dust pan.

4.2.2 Two templates as shown in Figure 2 are needed to isolate material on the conveyor belt.

4.2.3 An automated belt sampler may be used.

4.3 Serpentine Aggregate Covered Surfaces.

A shovel, a hand or machine-operated auger or other suitable equipment can be used to collect samples of aggregate materials on covered surfaces.

4.3.1 Hand-Operated Augers.

4.3.1.1 Helical Augers-Small lightweight augers such as spiral-type augers and ship-type augers may be used. A description of these augers can be found in ASTM D1452-80, which is incorporated herein by reference.

4.3.1.2 Orchard barrel and open spiral-type tubular augers may be used to collect samples. These augers range in size from 1.5 through 8 inches, and have the common characteristic of appearing essentially tubular when viewed from the digging end. Further description of these auger types can be found in ASTM D1452-80.

4.3.1.3 Clam Shell or Iwan-Type post-hole augers may be used to collect samples from surfaces generally 2 through 8 inches in diameter and have a common mean of blocking the escape of soil from the auger. Further description of these augers can be found in ASTM D1452-80.

4.3.2 Machine-Operated Augers

Machine-Operated Augers such as helical augers and stinger augers may be used. These augers are normally operated by heavy-duty, high-torque machines, designed for heavy construction work. Further description of these augers can be found in ASTM D1452-80.

4.3.3 A round point shovel can also be used to obtain a sample of aggregate covered surface material.

5 SAMPLING

The sampling procedure has been developed to provide an unbiased collection of bulk samples. A sampling plan, including a description of how the grab samples will be randomly collected and the number of samples to be collected, shall be developed. Prior to conducting any sampling the sampling plan shall be submitted to the Executive Officer for approval, if the sampling is conducted for determining compliance with a rule or regulation. The amount of composite 200 mesh material, as described below, shall be sufficient to provide sample to the source or Executive Officer, if requested, and a sample to be archived for future use.

A single test as described below shall cover:

a) 1000 tons of aggregate for piles and conveyor belts, or
b) one acre aggregate covered surface, or
c) one mile of aggregate covered road, or
d) two acres or two miles of dual aggregate covered shoulders.

Exposure to airborne asbestos fibers is a health hazard. Asbestos has been listed by the Governor as causing cancer and identified by the Air Resources Board as a toxic air contaminant. Serpentine aggregate may contain asbestos. Bulk samples collected can contain friable asbestos fibers and may release fibers during sampling, handling or crushing steps. Adequate safety precautions should be followed to minimize the inhalation of asbestos fibers. Crushing should be carried out in a ventilated hood with continuous airflow (negative pressure) exhausting through an HEPA filter. Handling of samples without these precautions may result in the inhalation of airborne asbestos fibers.

5.1 Serpentine Aggregate Storage Piles.

Serpentine aggregate storage piles typically have a conical or a triangular prism shape. The aggregate is introduced at the top of the pile and is allowed to flow over the side. This action, called sloughing, causes a size segregation to occur with the finer material deposited towards the top of the pile.

The locations where grab samples will be taken are randomly chosen over the surface of the pile. The method of randomly choosing the sampling locations is left up to sampling personnel but must follow the procedures specified in the sampling personnel plan. For 1000 tons of product, a grab sample shall be taken at a minimum of three randomly chosen sampling locations. A minimum of three grab samples shall be taken even if the product pile contains less than 1000 tons of material. The slough is raked or shoveled away from the sampling location. A sampling apparatus is inserted one foot into the pile and the material is removed and is placed in an appropriate sized sampling container. Some of the possible sampling apparatus is discussed in Section 4.1. Each of the grab samples shall be placed in the same sample container. This composited sample shall be crushed to produce a material with a nominal size of less than three-eighths of an inch. Before crushing, the sample must be adequately dried. ASTM Method C-702-80, which is incorporated herein by reference, shall be used to reduce the size of the crushed grab sample to a one pint aliquot. The one pint aliquot shall be further crushed using a Braun mill or equivalent to produce a material of which the majority shall be less than 200 Tyler mesh. An aliquot of the 200 mesh material shall be put into a labeled sealed container. The label shall contain all the information described in Section 6 (except item 4).

5.2 Serpentine Aggregate Conveyor Belts.

Serpentine aggregate is transported from the rock crushing plant to a product stacking belt and finally to a storage pile or to a waiting truck for delivery to a buyer.

The grab samples shall be taken from the product stacking belt or if this is not possible then at the first transfer point before the stockpile. The grab samples shall be collected by stopping the belt a minimum of three times or using an automated sampler. The method of randomly choosing the sampling locations and intervals is left up to sampling personnel but must follow the procedure specified in the sampling plan. For 1000 tons of product, a grab sample is taken at a minimum of three randomly selected intervals. A minimum of three samples shall be taken even if the generated product is less than 1000 tons. Each time the belt is stopped to take a grab sample, templates, as shown in Figure 2, are placed a minimum of six inches apart to isolate the material on the belt. The material within the templates is removed with a small shovel or with a brush and a dust pan for the finer material and is placed in an appropriate sized sampling container. This composited sample shall be crushed to produce a material with a nominal size of less than three-eighths of an inch. Before crushing, the sample must be adequately dried. ASTM Method C-702-80, which is incorporated herein by reference, shall be used to reduce the size of the crushed grab sample to a one pint aliquot. The one pint aliquot shall be further crushed using a Bruan mill or equivalent to produce a material which the majority of which shall be less than 200 Tyler mesh. An aliquot of the 200 mesh material shall be put into a labeled sealed container. The label must contain all the information listed in Section 6 (except item 4).

5.3 Serpentine Aggregate Covered Surfaces.

5.3.1 Serpentine Aggregate Covered Roads. A serpentine aggregate-covered road shall be characterized by taking grab samples from a minimum of three randomly chosen locations per mile of road. The method of randomly choosing the sampling locations is left up to sampling personnel but must follow the procedures specified in the sampling plan. A minimum of three samples shall be taken even if the road is less than one mile long. Section 4.3 describes some of the possible sampling apparatus used to collect the grab samples. Grab samples shall not contain underlying soils. Each of the grab samples shall be placed in the same sample container. This composited sample shall be crushed to produce a material with a nominal size of less than three-eighths of an inch. Before crushing, the sample must be adequately dried. ASTM Method C-702-80, which is incorporated herein by reference, shall be used to reduce the size of the crushed grab sample to a one pint aliquot. The one pint aliquot shall be further crushed using a Bruan mill or equivalent to produce a material which the majority of which shall be less than 200 Tyler mesh. An aliquot of the 200 mesh material shall be put into a labeled sealed container. The label must contain all the information listed in Section 6 (except item 4).

5.3.2 Serpentine Aggregate Covered Areas

A serpentine aggregate-covered play yard or parking lot shall be characterized by taking grab samples from a minimum of three randomly chosen locations per acre. The method of randomly choosing the sampling locations is left up to sampling personnel but must follow the procedures specified in the sampling plan. A minimum of three samples shall be taken even if the road is less than one mile long. Section 4.3 describes some of the possible sampling apparatus used to collect the grab samples. Grab samples shall not contain underlying soils. Each of the grab samples shall be placed in the same sample container. This composited sample shall be crushed to produce a material with a nominal size of less than three-eighths of an inch. Before crushing, the sample must be adequately dried. ASTM Method C-702-80, which is incorporated herein by reference, shall be used to reduce the size of the crushed grab sample to a one pint aliquot. The one pint aliquot shall be further crushed using a Bruan mill or equivalent to produce a material which the majority of which shall be less than 200 Tyler mesh. An aliquot of the 200 mesh material shall be put into a labeled sealed container. The label must contain all the information listed in Section 6 (except item 4).

5.3.3 Serpentine Aggregate Covered Road Shoulders

The sampling procedure specified in Section 5.3.1 or 5.3.2 shall be used for road shoulders covered with serpentine aggregate. The only difference is that a minimum of three grab samples shall be taken over a length of two miles of shoulder or over an area of two acres of shoulder surface. The word shoulder is meant to imply shoulders on both sides of the road. For serpentine aggregated covered shoulders, the sampling plan specified in Section 5 shall indicate whether the samples are collected on a two mile or two acre basis.

6 SAMPLING LOG

A sample log must be kept showing:

1) A unique sample number.
2) Facility name.
3) Facility address or location where sample is taken.
4) A rough sketch, video tape, or photograph of the specific sampling locations.
5) Date and time of sampling.
6) Name of person performing sampling.

7 ANALYTICAL PROCEDURES

7.1 Principle and Applicability.

Samples of serpentine aggregate taken for asbestos identification are first examined for homogeneity and preliminary fiber identification at low magnification. Positive identification of suspect fibers is made by analysis of subsamples with the polarized light microscope.

The principles of optical mineralogy are well established.[2,3] A light microscope equipped with two polarizing filters coupled with dispersion staining is used to observe specific optical characteristics of a sample. The use of plane polarized light allows the determination of refractive indices along specific crystallographic axes. Morphology and color are also observed. A retardation plate is placed in the polarized light path for determination of the sign of elongation using orthoscopic illumination. Orientation of the two filters such that their vibration planes are perpendicular (cross polars) allows observation of the birefringence and extinction characteristics of anisotropic particles.

Quantitative analysis involves the use of point counting. Point counting is a standard technique in petrography for determining the relative areas occupied by separate minerals in thin sections of rock. Background information on the use of point counting[3] and the interpretation of point count data[4] is available.

This method is applicable to all bulk samples of serpentine aggregate submitted for identification and quantification of asbestos components.

7.2 Range.

The analytical method may be used for analysis of samples containing from 0 to 100 percent asbestos. The upper detection limit is 100 percent. The lower detection limit is 0.25 percent.

7.3 Interferences.

Fibrous organic and inorganic constituents of bulk samples may interfere with the identification and quantitation of the asbestos content. Fine particles of other materials may also adhere to fibers to an extent sufficient to cause confusion in the identification.

7.4 Analytical Uncertainty.

The uncertainty method is two percent if twenty asbestos fibers are counted in a sample of 400 particles. The uncertainty of the analytical method may be assessed by a 95% confidence interval for the true percentage of asbestos fibers in the rock. The number of asbestos fibers in the sample is assumed to have a binomial distribution. If twenty asbestos fibers are found in a sample of 400 particles, a one-sided confidence interval for the true percentage has an upper bound of seven percent or an analytical uncertainty of two percent.[11] The confidence interval used here is an "exact" interval computed directly from the binomial distribution.

7.5 Apparatus.

7.5.1 Microscope. A low-power binocular microscope, preferable stereoscopic, is used to examine the bulk sample as received.

* Microscope: binocular, 10-45X
* Light Source: incandescent, fluorescent, halogen or fiber optic
* Forceps, Dissecting Needles, and Probes
* Glassine Paper, Clean Glass Plate, or Petri dish
* Compound Microscope requirements: A polarized light microscope complete with polarizer, analyzer, port for wave retardation plate, 360° graduated rotating stage, substage condenser, lamp, and lamp iris
* Polarized Light Microscope: described above
* Objective Lenses: 10X
* Dispersion Staining Objective Lens: 10X
* Ocular Lens: 10X
* Eyepiece Reticule: 25 point or 100 point Chalkley Point Array or cross-hair
* Compensator Plate: 550 millimicron retardation
* First Order Red I Compensator: 530 nanometers

7.6 Reagents.

Refractive Index Liquids: 1.490 - 1.570, 1.590 - 1.720 in increments of 0.002 or 0.004.

Refractive Index Liquids for Dispersion Staining: High-dispersion series, 1.550, 1.605, 1.630 (optical).

UICC Asbestos Reference Sample Set: Available from UICC MRC Pneumoconiosis Unit, Lisndough Hospital Penarth, Glamorgan CF6 1xw, UK and commercial distributors.

Tremolite-asbestos: Available from J. T. Baker.

Actinolite-asbestos: Available from J. T. Baker.

Chrysotile, Amosite, and Crocidolite is available from the National Institute of Standards and Technology.

Anthrophyllite, Tremolite, Actinolite will be available from the National Institute of Standards and Technology during the first quarter of 1990.

8 PROCEDURES

Exposure to airborne asbestos fibers is a health hazard. Bulk samples submitted for analysis are usually friable and may release fibers during handling or matrix reduction steps. All samples and slide preparations should be carried out in a ventilated hood or glove box with continuous airflow (negative pressure) exhausting through an HEPA filter. Handling of samples without these precautions may result in exposure of the analyst and contamination of samples by airborne fibers.

8.1 Sample Preparation.

An aliquot of bulk material is removed from the one pint sample container. The aliquot is spread out on a glass slide. A drop of staining solution with appropriate refractive index is added to the aliquot. A cover slide is placed on top of the sample slide.

The first preparation should use the refractive index solution for Chrysotile. If during the identification phase other asbestiforms are suspected to be present in the sample, due to their morphology, then additional analyses shall be performed with the appropriate solutions. Report the percentages of each asbestiform and combine percentages to determine total asbestos concentrations.

8.2 Fiber Identification.

Positive identification of asbestos requires the determination of the following optical properties:

Morphology (3 to 1 minimum aspect ratio)
Color and plechroism
Refractive indices
Birefringence
Extinction characteristics
Sign of elongation

Table 3 lists the above properties for commercial asbestos fibers. Natural variations in the conditions under which deposits of asbestiform minerals are formed will occasionally produce exceptions to the published values and differences from the UICC standards. The sign of elongation is determined by use of the compensator plate and crossed polars. Refractive indices may be determined by the Becke line test. Becke line test or dispersion staining shall be used to identify asbestos fibers. Central stop dispersion staining colors are presented in Table 4. Available high-dispersion (HD) liquids should be used.

8.3 Quantification of Asbestos Content.

Asbestos quantification is performed by a point-counting procedure. An ocular reticle (point array) or cross-hair is used to visually superimpose points on the microscope field of view. The point counting rules are as follows:

1. Record the number of points positioned directly above each particle or fiber.

2. Record only one point if two points are positioned over same particle or fiber.

3. Record the number of points positioned on the edge of a particle or fiber.

4. If an asbestos fiber and a matrix particle overlap so that a point is superimposed on their visual intersection, a point is scored for both categories.

5. If a test point lies over an ambiguous structure, no particle or fiber is recorded. Examples of "ambiguous" structures are:

   a) fibers whose dispersion colors are difficult to see

   b) structures too small to categorize.

6. A fiber mat or bundle is counted as one fiber.

For the purpose of the method, "asbestos fibers" are defined as mineral fibers having an aspect ratio greater than 3:1 and being positively identified as one of the minerals in Table 3.

A total of 400 points superimposed on either asbestos fibers or nonasbestos matrix material must be counted over at least eight different preparations of representative subsamples. Take eight forceps samples and mount each separately with the appropriate refractive index liquid. The preparation should not be heavily loaded. The sample should be uniformly dispersed to avoid overlapping particles and allow 25 - 50 percent empty area within the fields of view. Count 50 nonempty points on each preparation, using either

a reticle with 100 points (Chalkley Point Array) and counting 25 points in at least two randomly selected fields.

or

a reticle with 25 points (Chalkley Point Array) and counting at least two randomly selected fields.

or

a reticle with a standard cross-hair and counting at least 50 randomly selected fields.

For samples with mixtures of isotropic and anisotropic materials present, viewing the sample with slightly uncrossed polars or the addition of the compensator plate to the polarized light path will allow simultaneous discrimination of both particle types. Quantitation should be performed at 100X. Confirmation of the quantitation result by a second analyst on 10 percent of the analyzed samples should be used as standard quality control procedure. All optical properties in Section 8.2 shall be determined to positively identify asbestos.

EXCEPTION I

If the sample is suspected of containing no asbestos a visual technique can be used to report that the sample does not contain asbestos. The rules are as follows:

1. Prepare three slides as described in Section 8.3.

2. View 10 fields per preparation. Identify all fibers.

3. If all fibers are nonasbestos, report no asbestos were found and that visual technique was used.

4. If one fiber is determined to be asbestos, discontinue the visual method and perform the point counting technique as described above.

EXCEPTION II

If the sample is suspected to have an asbestos content in excess of ten percent, a visual technique can be used to report that the sample contains greater than ten percent asbestos. The standard operating procedure of the visual technique allowed in the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program, Bulk Asbestos Handbook, National Institute of Standards and Technology publication number NISTIR 88-3879 dated October 1988, which is incorporated herein by reference, shall be followed.

9 CALCULATIONS

The percent asbestos is calculated as follows:

$$\% \text{ asbestos} = \left(\frac{a}{n}\right) 100\%$$

Where:

a	=	number of asbestos counts
n	=	number of nonempty points counted (400)
If a	=	0, report "No asbestos detected."
If a	>	0, report the calculated value to the nearest 0.25%

If "no asbestos detected: is reported by the point counting technique, the analyst may report the observation of asbestos fibers in the non-counted portions of the sample.

10 ALTERNATIVE METHODS

10.1 Alternative Sampling Methods.

Alternative sampling methods may be used as long as they are substantially equivalent to the sampling methods discussed in Section 5 and approved by the Executive Officer of the Air Resources Board. The ARB Executive Offcier may require the submittal of test data or otehr information to demonstrate equivalency.

10.2 Analytical Methods.

An alternative analytical method may be used as longas it produces results substantially equivalent to the results produced by the point counting method and approved by the Executive Officer of the Air Resources Board. The ARB Executive Officer may require the submittal of test data or other information to demonstrate equivalency.

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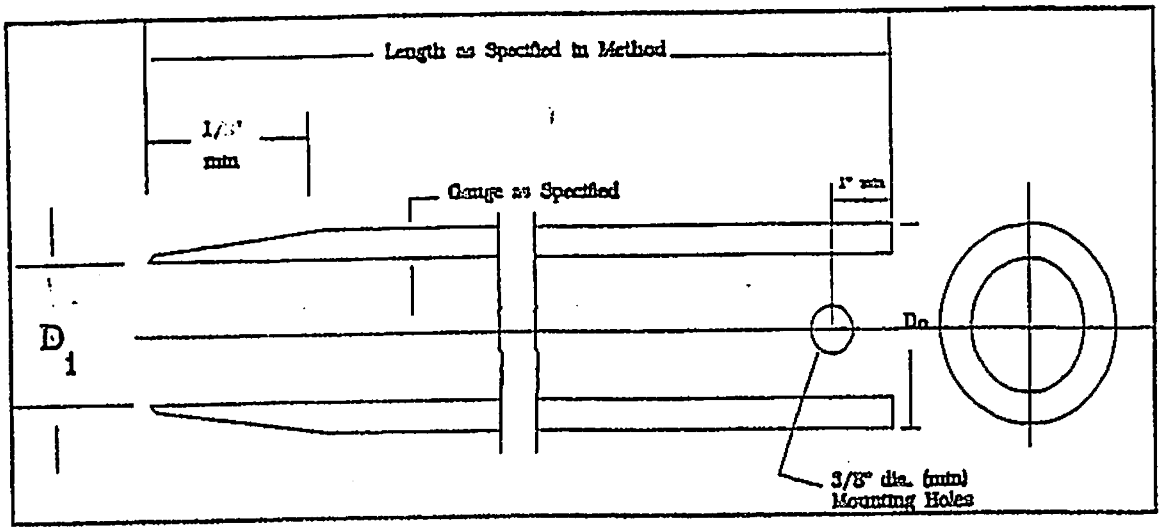
Figure 1

Thin Wall Tube for Sampling



Note 1 Minimum of two mounting holes on opposite sides for 2 to 3 inch diameter sampler.

Note 2 Minimum of four mounting holes spaced at 90° for samplers 4 inch diameter and larger.

Note 3 Tube held with hardened screws.

Note 4 Two inch outside-diameter tubes are specified with an 18-guage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-guage tubes are generally readily available.

Table 1

Suitable Thin Walled Steel Sample Tube[A]

OUTSIDE DIAMETER:			
iches	2	3	5
millimeters	50.8	76.2	127
WALL THICKNESS:			
Bwg	18	16	11
inches	0.049	0.065	0.120
millimeters	1.24	1.65	3.05
TUBE LENGTH:			
inches	36	36	54
meters	0.91	0.91	1.45
CLEARNACE RATIO, %	1	1	1

[A] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

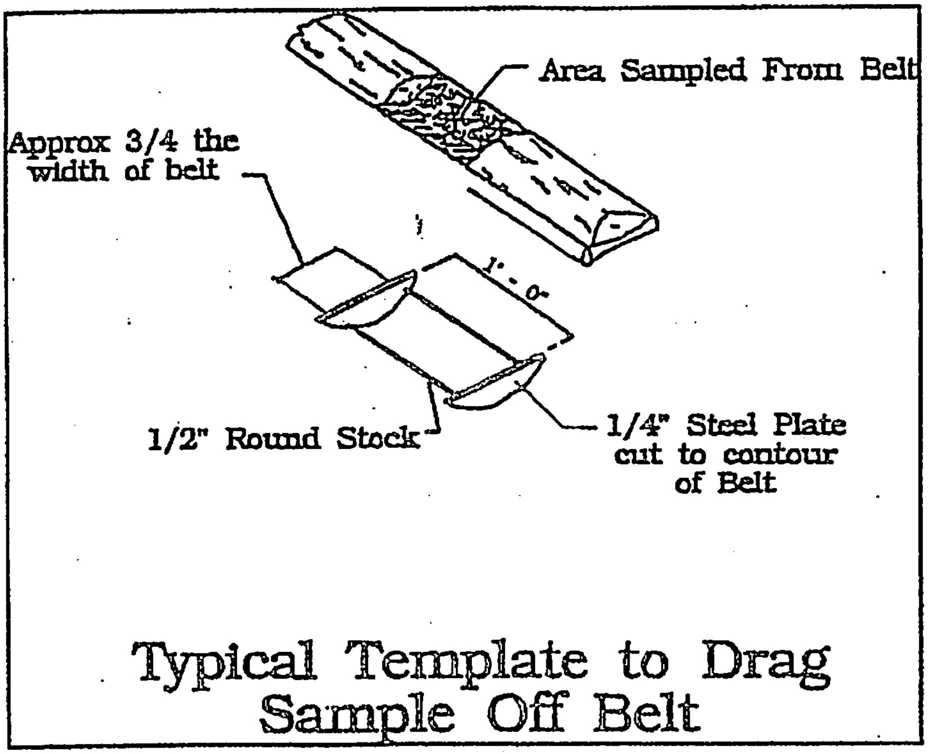
Table 2

Dimensional Tolerances for Thin Walled Tubes

Nominal Tube Diameters from Table 1[^] Toelrances, inches			
Size Outside Diameter	2	3	4
Outside Diameter	+0.007 -0.000	+0.010 -0.000	+0.015 -0.000
Inside Diameter	+0.000 -0.007	+0.000 -0.010	+0.000 -0.015
Wall Thickness	+0.007	+0.010	+0.015
Ovality	0.015	0.020	0.030
Straightness	0.030/ft	0.030/ft	0.030/ft

^ Intermediate or larger diameters should be proportional. Tolerances shown are essentially standard commercial manufacturing tolerances for seamless steel mechanical tubing. Specify only two of the first three toelrances; O. D. and I. D. or O. D. and Wall, or I. D. and Wall.

Figure 2



Area Sampled From Belt
Approx 3/4 the width of belt
1' - 0"
1/2" Round Stock
1/4" Steel Plate cut to contour of Belt
Typical Template to Drag Sample Off Belt

Table 3

Optical Properties of Asbestos Fibers

Mineral	Morphology[a], color	Refractive Indices[b] alpha	gamma	Birefringence	Extinction	Sign of Elongation
Chrysotile (asbestiform serpentine)	Wavy fibers. Fiber bundles have splayed ends and "kinks." Aspect ratio typically >10:1. Colorless[c], nonpleochloric.	1.493 - 1.560	1.517 - 1.562[f] (normally 1.556)	0.002 - 0.014	‖ to fiber length	+ (length slow)
Amosite (asbestiform grunerite)	Straight, rigid fibers. Aspect ratio typically >10:1. Colorless to brown, nonpleochroic or weakly so. Opaque inclusions may be present.	1.635 - 1.696	1.655 - 1.729[f] (normally 1.696 - 1.710)	0.020 - 0.33	‖ to fiber length	+ (length slow)
Crocidolite (asbestiform riebeckite)	Straight, rigid fibers. Thick fibers and bundles common, blue to purple-blue in color. Pleochroic. Birefringence is genreally masked by blue color.	1.654 - 1.701	1.668 - 1.717[e] (normally close to 1.700)	0.014 - 0.016	‖ to fiber length	- (length fast)
Anthophyllite-asbestos	Stright fibers and fiber bundles showing spalyed ends. Colorless to light brown. pleochroic absent.	1.596 - 1.652	1.615 - 1.676[f]	0.019 - 0.024	‖ to fiber length	+ (length slow)
Tremolite-actinolite-asbestos	Straight and curved fibers[d] and fiber bundles. Large bundles show spalyed ends. Tremolite is colorless and actinolite is green. Weakly to moderately pleochroic.	1.599 - 1.668	1.622 - 1.688[f]	0.023 - 0.020	‖ to fiber length	+ (length slow)

a From Reference 6; colors cited are seen by observation with plane polarized light.

b From Reference 7 and 9.

c Fibers subjected to heating may be brownish.

d Fibers defined as having aspect ratio >3:1.

e ⊥ to fiber length.

f ‖ to fiber length.

Table 4

Central Stop Dispersion Staining Colors[a]

Mineral	RI Liquid	nu ⊥	nu ‖
Chrysotile	1.550HD	blue	blue-magneta
Amosite	1.680	blue-magenta to pale blue	golden-yellow
	1.550HD	yellow to white	yellow to white
Crocidolite[b]	1.700	red-magenta	blue-magenta
	1.550HD	yellow to white	yellow to white
Anthophyllite	1.605HD	blue	gold to gold-magenta
Tremolite	1.605HD[c]	pale blue	yellow
Actinolite	1.630HD	gold-magenta to blue	gold
	1.630HD[c]	magenta	golden-yellow

a From Reference 11.10.

b Blue absorption color.

c Oblique extinction view.

Division 3. Air Resources Board

Chapter 1. Air Resources Board

Subchapter 7.5. Airborne Toxic Control Measures

§ 93106. Asbestos Airborne Toxic Control Measure--Asbestos-Containing Serpentine.

(a) Definitions. For the purposes of this section, the following definitions shall apply:

(1) "Aggregate" means a mixture of mineral fragments, sand, gravel, rocks, or similar minerals.

(2) "Alluvial deposit" means any deposit of sediments laid down by running water including but not limited to streams and rivers.

(3) "ARB Test Method 435" means the test method specified in title 17, California Code of Regulations, section 94147.

(4) "Asbestos" means asbestiforms of the following hydrated minerals: chrysotile (fibrous serpentine), crocidolite (fibrous riebeckite), amosite (fibrous cummingtonite--grunerite), fibrous tremolite, fibrous actinolite, and fibrous anthophyllite.

(5) "Asbestos-containing serpentine material" means serpentine material that has an asbestos content greater than five percent (5.0%) as determined by ARB Test Method 435.

(6) "Receipt" means any written acknowledgement that a specified amount of serpentine material was received, delivered, or purchased. Receipts include, but are not limited to, bills of sale, bills of lading, and notices of transfer.

(7) "Road surface" means the traveled way of a road and any shoulder which extends up to 10 feet from the edge of the traveled way.

(8) "Sand and gravel operation" means any aggregate-producing facility operating in alluvial deposits.

(9) "Serpentine" means any form of hydrous magnesium silicate minerals--including, but not limited to, antigorite, lizardite, and chrysotile.

(10) "Serpentine material" is any material that contains at least ten percent (10%) serpentine as determined by a registered geologist. The registered geologist must document precisely how the serpentine content of the material in question was determined.

(11) "Surfacing" means the act of covering any surface used for purposes of pedestrian, vehicular, or nonvehicular travel including, but not limited to, roads, road shoulders, streets, alleys, lanes, driveways, parking lots, playgrounds, trails, squares, plazas, and fairgrounds.

(b) Requirements for use or sale of serpentine material.

(1) No person shall use or apply serpentine material for surfacing in California unless the material has been tested using ARB Test Method 435 and determined to have an asbestos content of five percent (5.0%) or less. A written receipt or other record documenting the asbestos content shall be retained by any person who uses or applies serpentine material, for a period of at least seven years from the date of use or application, and shall be provided to the Air Pollution Control Officer or his designee for review upon request.

(2) Any person who sells, supplies, or offers for sale serpentine material in California shall provide with each sale or supply a written receipt containing the following statement: "Serpentine material may have an asbestos content greater than five percent (5.0%). It is unlawful to use serpentine material for surfacing unless the material has been tested and found to contain less than or equal to five percent (5.0%) asbestos. All tests for asbestos content must use California Air Resources Board Test Method 435, and a written record documenting the test results must be retained for at least seven years if the material is used for surfacing."

(3) No person shall sell, supply, or offer for sale serpentine material for surfacing in California unless the serpentine material has been tested using ARB Test Method 435 and determined to have an asbestos content of five percent (5.0%) or less. Any person who sells, supplies, or offers for sale serpentine material that he or she represents, either orally or in writing, to be suitable for surfacing or to have an asbestos content that is five percent (5.0%) or less, shall provide to each purchaser or person receiving the serpentine material a written receipt which specifies the following information: the amount of serpentine material sold or supplied; the dates that the serpentine material was produced, sampled, tested, and supplied or sold; and the asbestos content of the serpentine material as measured by ARB Test Method 435. A copy of the receipt must, at all times, remain with the serpentine material during transit and surfacing.

(4) Any person who sells, supplies, or offers for sale serpentine material, shall retain for a period of at least seven years from the date of sale or supply, copies of all receipts and copies of any analytical test results from asbestos resting of the serpentine material. All receipts and test results shall be provided to the Air Pollution Control Officer or his designee for review upon request.

(5) If ARB Test Method 435 has been used to perform two or more tests on any one volume of serpentine material, whether by the same or a different person, the arithmetic average of these test results shall be used to determine the asbestos content of the serpentine material.

(c) Exemptions.

(1) The provision of subdivisions (b)(2) through (b)(5) shall not apply to sand and gravel operations.

(2) The provisions of subdivision (b)(1) shall not apply to roads located at serpentine quarries, asbestos mines, or mines located in serpentine deposits.

(3) The provisions of subdivision (b)(1) shall not apply to maintenance operations on any existing road surfaces, or to the construction of new roads in serpentine deposits, as long as no additional asbestos-containing serpentine material is applied to the road surface.

(4) Emergency Road Repairs:

The air pollution control officer may issue a temporary exemption from the requirements of subdivision (b)(1) to an applicant who demonstrates that a road repair is necessary due to a landslide, flood, or other emergency and that the use of material other than serpentine is not feasible for this repair. The air pollution control officer shall specify the time during which such exemption shall be effective, provided that no exemption shall remain in effect longer than six (6) months.

(5) Bituminous and Concrete Materials:

The provisions of subdivision (b) shall not apply to serpentine material that is an integral part of bituminous concrete, portland cement concrete, bituminous surface, or other similar cemented materials.

(6) The provisions of subdivision (b)(1) shall not apply to landfill operations other than the surfacing of public-access roads dedicated to use by vehicular traffic.

NOTE: Authority cited: Sections 39600, 39601, 39650 and 39666, Health and Safety Code. Reference: Sections 39650 and 39666, Health and Safety Code.

REFERENCE

[illegible]nalysis o[illegible]
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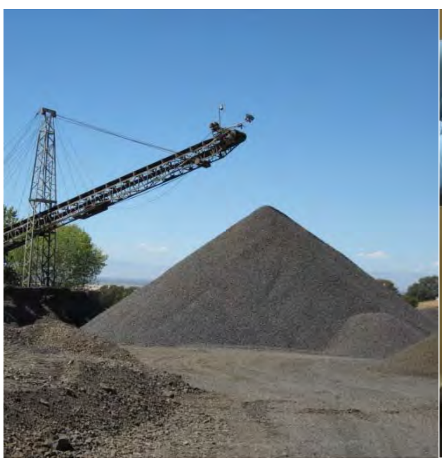
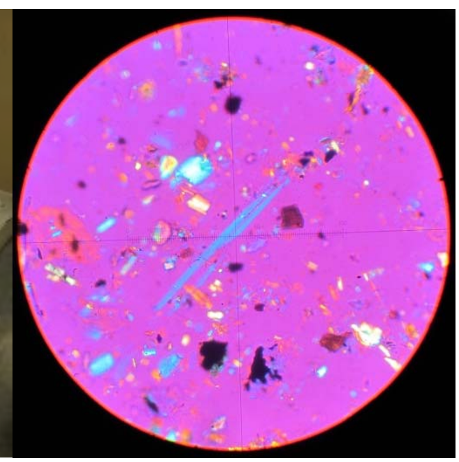
Appendix II

California Environmental Protection Agency
AIR RESOURCES BOARD

IMPLEMENTATION GUIDANCE DOCUMENT
Air Resources Board Test Method 435
Determination of Asbestos Content of Serpentine Aggregate

Field Sampling and Laboratory Practices





ARB Monitoring and Laboratory Division
Quality Management Branch
Quality Management Section
April 2017

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IMPLEMENTATION GUIDANCE DOCUMENT
FIELD SAMPLING AND LABORATORY PRACTICES

Air Resources Board Test Method 435
Determination of Asbestos Content of Serpentine Aggregate

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FIELD SAMPLING AND LABORATORY PRACTICES

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Determination of Asbestos Content of Serpentine Aggregate

EXECUTIVE SUMMARY

In 1986, asbestos was identified by the California Air Resources Board (ARB or Board) as a toxic air contaminant. In its April1990 Board hearing, ARB adopted the first Asbestos Airborne Toxic Control Measure (ATCM) for Surfacing Applications (Surfacing ATCM) to limit the public's exposure to airborne asbestos from unpaved surfaces. At its July 2000 public hearing, ARB approved amendments to the Surfacing ATCM, further limiting the asbestos content of materials used for unpaved surfacing to less than 0.25 percent. The test method required to determine the asbestos content is ARB Test Method 435: Determination of Asbestos Content of Serpentine Aggregate (M435).

At its July 2001 Board hearing, ARB approved a second asbestos ATCM for construction, grading, quarrying, and surface mining operations. This ATCM requires operators to employ the best available dust mitigation measures during road building and maintenance activities, construction and grading operations, and quarrying and surface mining operations in areas where naturally occurring asbestos (NOA) is likely to be found. This ATCM also references M435 as a laboratory test method to determine the asbestos content of bulk samples.

ARB staff research and a M435 interlaboratory study have shown that M435 sample processing and analytical procedures vary among commercial laboratories performing M435 analyses and these differences can lead to variable reported asbestos content of the same, or similar, asbestos-containing samples. In response, this guidance document was prepared to assist laboratories, consultants, local air pollution control districts, and other stakeholders in the application and performance of ARB M435. This document is intended to be used in conjunction with M435. This document provides:

a) Recommendations to help ensure that a representative field sample is obtained for a M435 analysis.
b) Recommended laboratory sample preparation procedures that will increase the representativeness of the pulverized portion of the field sample that is used for analysis by polarized light microscopy (PLM).
c) Guidance in asbestos analysis through the standardized use of PLM techniques for the optical characterization and quantification of asbestos.
d) Scientifically accepted quality control (QC) measures that can be applied to M435 to minimize field, laboratory, and analytical uncertainty.

If all parties involved in the collection, processing, and analysis of potential asbestos-containing aggregate follow the guidelines specified in this document, more accurate

and repeatable M435 asbestos content measurements will result. This will ultimately lead to better-informed decisions regarding naturally occurring asbestos related projects.

Key recommendations are summarized below:

Sampling Practices

a) Increase the number of random (grab) samples for each test in situations of observed heterogeneity. (M435 requires a minimum of three grab samples).
b) If sampling from piles, use insertion tubes instead of round point shovels or use a front loader to obtain a smaller sample from various levels and locations of the larger pile before subsampling.
c) Choose to sample aggregates on conveyor belts closest to the final product rather than piles if at all possible.
d) Aim for a field sample volume of approximately two to three liters.

General Laboratory Processes

a) Employ chain of custody procedures and acceptance criteria for samples.
b) Prepare written laboratory standard operating procedures specific for M435.
c) Ensure equipment cleanliness during all phases of M435 activities; for some processes, specific recommended cleaning procedures are provided.

Laboratory Sample Processing

a) Use a jaw crusher and Braun mill pulverizer to produce the rock powder.
b) Include a mixing step to increase homogeneity of the powdered sample analyzed, to increase the likelihood that the material analyzed is representative of the field sample, as well as to increase the accuracy and precision of the analytical results.
c) Perform routine particle size calibration checks to ensure that samples are not over-pulverized or incompletely pulverized.

Laboratory Sample Analysis

a) Standardize the amount of powdered sample material mounted on a slide.
b) Identify suspect fibers as asbestos using only Tables 3 and 4 of M435.
c) Use a single crosshair eyepiece for asbestos quantification and at least 200X magnification for asbestos optical characteristics verification.
d) Enhance analysis quality control to include microscopist training, routine use of asbestos proficiency evaluation and interference mineral samples, analytical replicates, instrument cross checks, method validation, and verification of some PLM non-detect M435 results using another analytical method.

I. INTRODUCTION

I.1 Purpose

This guidance document was prepared to assist laboratories, consultants, local air pollution control districts, and other stakeholders in the application and performance of the California Air Resources Board (ARB or Board) Test Method 435--Determination of Asbestos Content of Serpentine Aggregate (M435). This document is intended to be used in conjunction with M435, which can be found in Appendix A.

ARB staff conducted an interlaboratory study (ILS) (Appendix B) that shows that sample processing and analytical procedures vary among commercial laboratories performing M435 analyses. This study indicates that these differences may lead to variable reported asbestos content of the same, or similar, asbestos-containing samples.

This document aims to clarify the stated procedures in M435 as well as provide recommendations regarding field sampling and laboratory practices. In addition, the document clarifies the different roles of using M435 in compliance with the two asbestos ATCMS for the analysis of bulk samples. The guidelines in this document, if adhered to by all parties involved in the collection and analysis of potential asbestos-containing aggregate, will yield more accurate and repeatable M435 asbestos content measurements.

I.2 Background

The California Toxic Air Contaminant Identification and Control Program, set forth in Health and Safety Code Section 39650 et seq. (H&SC §§ 39650-39675), requires ARB to identify and control toxic air contaminants (TAC). A TAC is defined as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health (H&SC § 39655). In 1986, asbestos was identified by the Board as a TAC; the Board also determined that there is not enough scientific evidence to identify an asbestos threshold exposure level below which no significant adverse health effects are anticipated (17 CCR § 93000).

In 1990, ARB adopted the first Asbestos Airborne Toxic Control Measure (ATCM) for Surfacing Applications (Surfacing ATCM) to limit the public's exposure to asbestos from unpaved surfaces (Appendix C). At its July 2000 public hearing, ARB approved amendments to the Surfacing ATCM, further limiting the asbestos content of material used for unpaved surfacing to less than 0.25 percent by point-count. The test method required to determine the asbestos content is M435 (17 CCR § 94147).

At its July 2001 Board hearing, ARB approved a second asbestos ATCM for construction, grading, quarrying, and surface mining operations (Construction ATCM). This ATCM requires operators to employ the best available dust mitigation measures during road building and maintenance activities, construction and grading operations, and quarrying and surface mining operations in areas where naturally occurring asbestos (NOA) is likely to be found (Appendix D). The Construction ATCM also references M435 as one among several laboratory test methods for the determination of asbestos content of bulk samples.

The more common circumstance is when the Construction ATCM requires a geologic evaluation of the presence or absence of asbestos in a certain location. M435 is not a substitute for a geologic evaluation of the likelihood of asbestos occurrence in an area. It is an appropriate test for the measurement of asbestos content of individual bulk samples.

I.3 Safety

Asbestos is classified as a TAC and a known human carcinogen by State, federal, and international agencies. The United States Environmental Protection Agency (U.S. EPA) classifies asbestos in Group A, as a human carcinogen (CASRN 1332-21-4). Similarly, the International Agency for Research on Cancer (IARC) classifies asbestos as carcinogenic to humans (Group 1) (IARC Monographs, 1987). Asbestos dust inhalation can initiate events that could result in asbestosis, lung cancer, or other asbestos-related diseases, such as mesothelioma.

In conducting the testing described in this document, as well as any preparatory and cleanup work, parties bear the responsibility of determining and implementing all of the appropriate health and safety practices to ensure compliance with local, State, and federal health and safety regulations. All activities associated with the handling of potential NOA should proceed as if asbestos were known to be present in the rock or soil, thereby initiating the appropriate safety precautions. In performing all of the preparation and testing described in this document, all applicable safety features and procedures for the equipment involved should be employed. In addition, ARB staff recommends that field personnel and laboratories consult an outside, independent industrial hygienist and safety professional to review their respective practices and recommend additional appropriate safety procedures where needed.

II. APPLICABILITY

II.1 Asbestos ATCM for Surfacing Applications (17 CCR § 93106)

M435 was adopted in 1991 in support of the Surfacing ATCM which sought to reduce asbestos emissions from unpaved roads and other applications by limiting the sale and use of asbestos-containing serpentine rock for surfacing applications.

M435 is the referenced test method required for the determination of asbestos content of a sample of surfacing aggregate material. M435 requires representative, unbiased sampling of industrial earth products, such as bulk aggregate materials at the production plant (e.g., in piles, conveyor belts) and at existing sites where surface covering can be assessed for asbestos content (e.g., on roads, road shoulders, driveways, parking lots, and other surfaces).

Aggregate-producing facilities operating in alluvial deposits, maintenance operations on existing roads, and construction materials of asphalt or concrete surfaces are exempted from the Surfacing ATCM. An exemption may also be sought for aggregate materials extracted from a property mapped within an ultramafic rock unit if a registered geologist has conducted a geologic evaluation and determined that serpentine or ultramafic rocks are not likely to be found on the property. A summary of this exemption appears below at Section II.3.

When the material to be tested for asbestos content consists of aggregate materials, then the use of M435 random sampling is appropriate. However, when the sampling is performed in order to assess the likelihood of geologic occurrences of asbestos, serpentine, or ultramafic rocks in an area, then a geologic evaluation of the property is necessary.

II.2 Asbestos ATCM for Construction, Grading, Quarrying, and Surface Mining Operations (17 CCR § 93105)

The Construction ATCM was adopted to reduce asbestos exposure associated with construction, grading, quarrying, and surface mining activities in areas where NOA is known or likely to be present. Specifically, these activities are subject to the Construction ATCM if they occur in mapped ultramafic rock units, or when NOA, serpentine, or ultramafic rocks are known to be present, or are discovered to be present after the start of operations in the area. M435 is referenced in the Construction ATCM as an approved test to determine the asbestos content of a bulk sample. The Construction ATCM requires work practices that will minimize dust emissions during these activities. The ATCM does not prohibit the above-mentioned activities.

A general exemption from the Construction ATCM may be sought and granted if a registered geologist conducts a geologic evaluation that determines that no serpentine or ultramafic rock is likely to be present in the area to be disturbed, a scenario which is not addressed in M435.

II.3 Exemption Via the Geologic Evaluation

This guidance document is not intended to discuss the ATCM exemption through a geologic evaluation in any great detail. It should be noted that, although M435 can be used for the analysis of bulk samples, and is referenced as a bulk analysis technique, the M435 random sampling procedure is not a substitute for a geologic evaluation of an area. The geologic exemption criteria are stated in the asbestos ATCMs. Exemptions for the Surfacing ATCM and the Construction ATCM require a registered geologist to conduct a geologic evaluation of the area to be disturbed. Furthermore, the M435 random sampling methodology does not address the investigation of the presence or absence of asbestos from surface rock outcrops or subsurface rock samples which may be needed to determine the likelihood of the presence of asbestos, serpentine, or ultramafic rocks in the area to be disturbed. Therefore, the random sample collection methodology, as written in M435, is not a substitute for targeted sampling that may be needed for the geologic evaluation of an area when seeking exemption from either asbestos ATCM. The California Geological Survey Special Publication 124 (Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California) provides general procedures for geologists to use when conducting NOA site investigations. Further clarifications regarding the asbestos ATCM requirements can be given by the Emissions Evaluation Section, Transportation and Toxics Division of the ARB.

M435 is an appropriate test for the measurement of asbestos content of individual bulk samples.

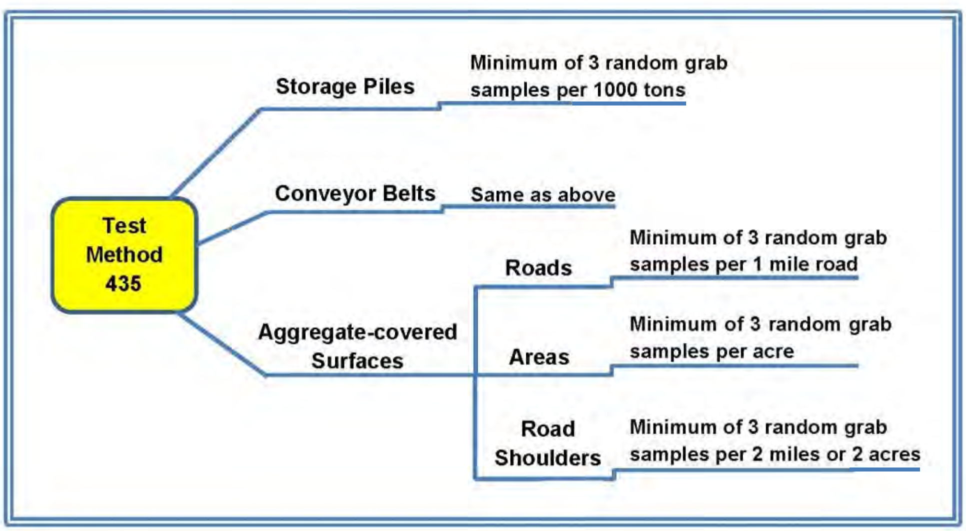
III. SAMPLING PRACTICES FOR AGGREGATE MATERIALS

III.1 Applicable Sources (M435 Section 3)

Field sampling in M435 is applicable for obtaining bulk material samples from three types of serpentine aggregate sources (Figure 1):

a) Storage piles.
b) Conveyor belts.
c) Aggregate-covered surfaces.

Figure 1. M435 Sampling Requirements for Aggregate Material



As defined in the Surfacing ATCM, the term “aggregate” means a mixture of mineral fragments, sand, gravel, cobbles, rocks, stones, or similar minerals that may or may not be crushed or screened. “Aggregate” does not include elemental metals, gemstones, petroleum products, organic materials, or mineral ore to be processed offsite of the property from which it was extracted (17 CCR § 93106(i)(1)). All recommended sampling procedures should comply with the procedures set forth by the Mine Safety and Health Administration (MSHA), and other safety standards.

III.2 Sampling Design (M435 Section 5)

M435 sampling procedures were developed to provide a collection of unbiased samples of aggregate materials. Prior to field sampling, a sampling plan, including a description of how many samples will be collected, shall be submitted to the appropriate local air district officer for approval, if the sampling is conducted for determining compliance with a rule or regulation. This should include a conceptual site model of the area and a description of how the random collection of samples will be conducted in order to generate a composited, representative sample.

Each M435 test must consist of at least three random grab samples that are composited in a sampling container for preparation and analysis. At the discretion of the person in charge of the sampling plan, more than the required three grab samples may be collected but the method of deciding where and how to collect additional grab samples must follow the specified procedure in the approved sampling plan. One way to increase the representativeness of a grab sample is to make sure that each grab sample consists of about 20 to 30 increments, depending on the size of rock fragments in the aggregate material (Interstate Technology Regulatory Council, 2012). It is recommended that the total volume of the composited sample not exceed about three quarts (approximately three liters). This sample volume of about three quarts could present issues of sample transport and storage that may need to be discussed with the analytical laboratory prior to sample collection.

In situations of observed aggregate heterogeneity, such as notably different rock types that may indicate variable sources of aggregate material, ARB staff recommends collecting more than the minimum of three grab samples, each consisting of about 20 to 30 increments. One should take into consideration potentially variable sources of the aggregate material, as may be indicated by different lithology, rock color, etc., and total sample volume, which should not exceed about three quarts (approximately three liters). If a sample area is expected to have significant heterogeneity, the sample area should be divided into multiple units prior to sample collection and representative samples should be collected from each unit.

III.3 Sampling Equipment and Procedures (M435 Sections 4 and 5)

The different acceptable sampling equipment and procedures for the respective aggregate sources are described in this section. It is important that field sampling begins with clean sampling equipment and that the equipment be thoroughly cleaned after each sample collection, following a written protocol, to prevent cross-sample contamination.

Storage Piles

Sampling of aggregate storage piles (Figures 2A, 2B) can be difficult because they typically have a conical shape which may be size-segregated. This is formed by the introduction of aggregate at the top of the pile, and coarser particles roll to the outside base of the pile, while leaving the finer material towards the top of the pile (sloughing). To collect a representative sample, it is important to dig into the pile to avoid the slough or size-segregated particles. One method to avoid the slough or size-segregated particles is to use a sampling tube inserted one foot (approximately 30.5 centimeters) into the pile. Another way is to use a round point shovel, and take equivolume sample increments from at least three separate locations: from the upper, middle, and lower portions of a pile. A greater number of grab samples enables one to collect material from multiple areas to better account for any variability of the aggregate material. The collected aggregate can then be transferred into a clean container of adequate size.

Figure 2A. Storage Piles of Crushed Natural Stone

The applicable diameter of the sampling tube equipment depends on the size of the aggregate particles. As described in M435 Tables 1 and 2 (Appendix A), thin-walled sampling tubes with an outside diameter between two to five inches (approximately 5.1 to 12.7 centimeters) and a length from 36 to 54 inches (approximately 91.4 to 137.2 centimeters) may be used for sampling in storage piles. The nominal diameter of the aggregate material determines the dimensions of the sampling tube. The sampling tube should have adequate strength so that it may be inserted one foot (approximately 30.5 centimeters) into the pile. Further descriptions of these tubes can be found in ASTM D 1587-83, which is incorporated in M435 by reference.

M435 also allows for the use of round point shovels. However, staff recommends the use of insertion tubes over shovels because insertion tubes do a better job of dealing with slough material. Shovels should only be used when the aggregate material is coarse or consists of mixed fine and coarse material that cannot be easily sampled with a tube.

ARB staff has also observed that aggregate sampling of stock piles in rock quarries is often done with power equipment. Using a front loader, a small sampling stockpile is made using materials taken from various levels and locations of the main stockpile (Figure 2B). After mixing the sampling stockpile with the front loader, several increments can be combined in a container as the field sample (ASTM D 75). Although different than M435 procedures, ARB staff is aware that this procedure is used in the industry to obtain representative aggregate samples for testing aggregate products. If material is taken from the upper, middle, and lower levels of the pile and then mixed, this procedure may also be effective in obtaining representative samples for M435 analysis.

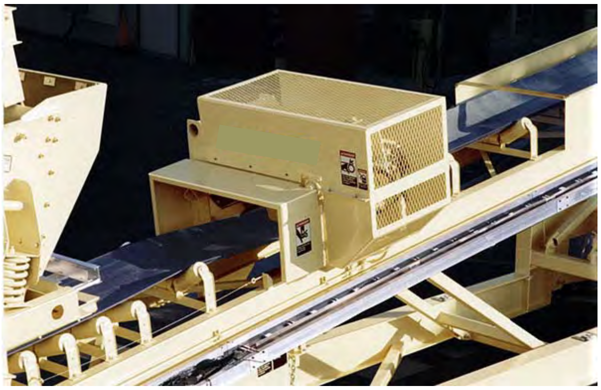
Figure 2B. Front Loader Sampling Aggregate Pile

Conveyor Belts

M435 samples can also be taken from conveyor belts (Figure 3A) that are used to transport aggregate materials. To perform the sampling procedures, conveyor belts should be manually stopped, locked, and tagged out. Two steel templates, cut to the specifications given in Figure 2 of M435 (Appendix A), can be used to isolate aggregate material that will be sampled. The steel templates are placed at least six inches (approximately 15.2 centimeters) apart and, using a small shovel, brush, and dust pan, all the aggregate material between them is collected. It is important that the distance between templates be maintained for every sampling event on the conveyor belt to collect equivolume increments. Therefore, the volume of aggregate material collected would depend on the distance between the templates, the width of the conveyor belt, and the thickness of the aggregate material on the conveyor belt. An automated belt sampler, if present, may also be used (Figure 3B). Sampling is to be done at least three times in randomly chosen locations. The aggregate materials collected are composited in a container of adequate dimensions. Although potentially more disruptive to an aggregate quarry's operations than sampling from piles, conveyor belt manual sampling is less susceptible to the sloughing effects observed in aggregate piles. An automatic belt sampler at the conveyor belt closest to the final product stream can provide representative aggregate samples most similar to the sellable product.

Figure 3A. Conveyor Belt for Aggregate Material

Figure 3B. Example of Automatic Conveyor Belt Sampler



Aggregate-covered Surfaces

For aggregate-covered surfaces (e.g., roads, road shoulders, parking or play areas, etc.) as shown in Figure 4, one can use manual or automatic augers, a shovel, or other suitable equipment for sampling. Sampling with an auger collects a variable volume of

Figure 4. Aggregate-covered Surfaces

aggregate materials, depending on the diameter of the sampling auger and the thickness of the compacted aggregate material bed to be sampled. The locations of sampling points are random, and the underlying soils are not included during sampling. Auger sampling is done at least three times and all the material collected is composited in one container.

Examples of the different auger types are given in M435 Section 4.3 (Appendix A) and detailed descriptions of these augers are found in ASTM D1452-80, which is incorporated in M435 by reference. The type of auger used depends on characteristics of the aggregate to be sampled, such as the nominal diameter, aggregate hardness, water content, sampling depth, etc. For example, a helical auger (Figure 5A) is good for boring holes quickly, but is difficult to use for removal of material. An orchard barrel auger (Figure 5B) works well in most soil conditions, but may bore more slowly than a helical auger through hard material. A clam shell type auger (Figure 5C) works for alternate digging and retrieving of sample materials, while the Iwan-type auger (Figure 5D) works well in stony soils. All sample increments collected are composited in a sample container.

<u>Field Sample Volume</u>

The volume of the field sample is not specifically stated in M435. However, a one-pint aliquot of the crushed field sample is required for pulverization. Therefore, by inference, one pint of aggregate material is the minimum size of a field sample.

Although laboratory personnel should not dictate sample volume, field personnel should be mindful of the dimensions of rocks they collect so that samples may be readily processed as determined by typical laboratory equipment size specifications or sample

Figure 5. Augers: A. Helical, B. Orchard Barrel, C. Clam Shell, D. Iwan-type

A. B. C. D.

handling capacities. For instance, some laboratories use rock crushers (e.g., jaw crushers, etc.) to reduce the nominal size of aggregate to less than 3/8-inch (less than 0.95-centimeter) diameter before pulverization. These rock crushers can process, within minutes, a two-quart (approximately two-liter) sample of aggregate rock fragments, ranging from approximately 1/2 to three inches (approximately 1.3 to 7.6 centimeters) in diameter. In addition, a laboratory may be using a mixer for homogenization (as recommended in this document). These mixers are also limited in terms of sample size mixing capacity. The three-dimensional (3-D) mixer tested by ARB staff has a mixing sample capacity of four quarts (approximately four liters).

In view of the equipment size limitations discussed above, ARB staff has determined that a rock aggregate sample volume of about two to three quarts (approximately two to three liters) is appropriate. Pulverization of approximately two quarts (approximately two liters) of fine rock aggregate with less than 3/8-inch (0.95 centimeter) diameter can result in a rock powder volume of about three quarts (approximately three liters). The volume increases due to an increase in interparticle spaces. Homogenization of this rock powder, when placed in a four-quart (approximately four-liter) mixing container, will require that some volume of head space be available within the container for the powder to be thoroughly mixed.

III.4 Sample Documentation (M435 Section 6)

As written in M435, a sample log must be kept showing:

a) Unique sample number.
b) Facility name and MSHA Mine ID number if applicable.
c) Facility address or location where sample was taken.
d) Rough sketch, video, or photograph of the specific sampling location.
e) Date and time of sampling.
f) Name of person performing sampling.

ARB staff believes that, absent unusual circumstances, these sample log requirements are sufficient.

IV. SAMPLE PROCESSING PRACTICES IN THE LABORATORY

Although sample preparation processes, such as drying, crushing, and sample size reduction, are discussed in the field sampling portion of M435 (M435 Section 5, Appendix A), these activities are best performed in a laboratory setting.

IV.1 Chain of Custody Procedures

Chain of custody (CoC) documentation maintains the integrity of samples by providing records regarding their source, control, transfer, processing, and analysis. In general, the purpose of CoC procedures is to provide accountability for, and documentation of, sample integrity from the time samples are collected to sample disposal. Sample custody documentation is just one of the many important components of data defensibility. M435 does not explicitly prescribe the use of CoC procedures, but such procedures are widely recognized as producing vital documentation when using data for regulatory and/or enforcement decisions. For M435 samples, ARB staff recommends a detailed CoC record that is initiated by field sampling personnel and documents at least the following:

a) Name and signature of client submitting the samples.
b) Company name, address, telephone numbers, and email address.
c) Date and time of submission.
d) Job site where samples were collected (may be coded).
e) Sample identification (may be coded).
f) Sample type description (e.g., rock, soil, aggregate, etc.) and sample volume.
g) Name and signature of laboratory personnel accepting custody.
h) Date and time of acceptance of samples.

ARB staff recommends the use of a laboratory information management system to track the location of samples, analytical results, identification of microscopists who performed the analyses, and the location of sample archives.

In order to maintain an adequate CoC, the laboratory may also choose to render some samples inadmissible for M435 analysis for several reasons, some of which may include but are not limited to the following:

a) Sample container is breached.
b) Several samples appear to have become commingled, contaminating each other (e.g., broken bags).

c) Insufficient volume of sample (i.e., less than the implicitly defined M435 minimum volume of one pint) or sample volume is different than what is indicated on the CoC.
d) Samples are not clearly identified and labeled.

Appendix I shows an example of what could be used as a Method 435 sample CoC. Further guidance on general CoC procedures can be found from many sources, one of which is provided below:

ASTM: http://www.astm.org/Standards/D4840.htm

IV.2 Drying

M435 requires that the sample be adequately dried before it is crushed, but does not provide details on how to accomplish this. The object of drying samples is to remove moisture that would hinder complete pulverization of the sample. Because complete pulverization is an important component in producing accurate and repeatable asbestos analytical results, appropriate and standardized laboratory drying procedures should be utilized.

ARB staff suggests the following drying steps to aid the pulverization process while reducing the potential for cross-contamination:

a) Use disposable metal pans for oven drying.
b) Label drying pans or place labeled tags in the pan for sample identification.
c) Transfer the sample into drying pan(s) under a negative air fume hood equipped with a high-efficiency particulate air (HEPA) filter, taking care that the depth of materials does not exceed 1.5 inches (approximately 3.8 centimeters) for uniform drying of samples. If a shorter drying time is needed, spread the sample to a thickness of about 0.5 inch (approximately 1.2 centimeters) and use several drying pans.
d) Remove and discard organic materials such as leaves, plant stems, roots, twigs, etc.
e) Completely cover the drying pans with clean paper towels fastened to the pan with clips.
f) Dry the samples at 230 degrees Fahrenheit (ºF) (110 degrees Celsius, ºC) in a constant-temperature oven with plus-or-minus 5 ºC accuracy for about 15 hours (overnight). Staff recommends keeping the oven-drying temperatures below 392 ºF (200 ºC) to avoid possible mineral alterations when a quicker oven-drying time is needed. The dried samples should have a gravimetric water content of about two to four percent, depending on the sample particle sizes (i.e., coarser samples retain less water and clayey samples retain more water).
g) Record the drying temperature and drying time on the sample analytical bench sheets.
h) Cool samples under a negative air fume hood that uses a HEPA filter.

i) Place disposable items used for drying in plastic bags that can be sealed and marked for proper waste disposal.
j) Ultrasonically clean non-disposable items used (e.g., clips, forceps, etc.).

IV.3 Crushing

Per M435, the composited sample must be crushed to produce a material with a nominal size of less than 3/8 inch (approximately 0.95 centimeter). Although not explicitly stated, this procedure is required so that the crushed material can be introduced into the sample intake of the Braun mill pulverizer (plate grinder).

ARB staff is aware of four methods that commercial laboratories use to ensure that the sample product is crushed to a size that is compatible with their pulverizing equipment:

a) Using a mechanical jaw crusher to reduce sample to a nominal size of less than 3/8 inch (approximately 0.95 centimeter).
b) Using a hammer to manually crush sample (usually contained in one or more plastic bags).
c) Requiring the submitted field sample to have specified size restrictions (e.g., small rock fragments) suitable only for the respective laboratory's pulverizing equipment.
d) Removing and discarding portions of the field sample submitted that are not compatible with or are too large for the laboratory's pulverizing equipment.

ARB staff recommends the use of jaw crushers (a) because they are reliable at producing less than 3/8-inch (approximately 0.95-centimeter) crushed rock material with relative ease. Rock samples with cross sections up to about 2.5 to three inches (approximately five to seven centimeters) are easily and uniformly crushed within minutes.

The jaw crusher should be operated in strict compliance with lockout/tagout and other safety procedures, as appropriate. (See reference section for Occupational Safety & Health Administration [OSHA] Lockout/Tagout Fact Sheet [2002]). The crusher should be adequately cleaned prior to use and operated under a HEPA filter enclosure with a minimum flow rate of 100 feet per minute (approximately 30.5 meters per minute). Recommended procedures on how to operate and clean the jaw crusher can be found in Appendix E.

ARB staff discourages the use of hammers (b) to crush rocks because of the increased likelihood of losing sample volume and the risk of spreading potentially asbestos-containing fragments in the processing room, even with the use of bags to enclose the sample. ARB staff believes that items (c) and (d) go against the original intent of M435 and are not consistent with good field and laboratory practices, especially if these practices are not documented in the appropriate standard operating procedure (SOP).

IV.4 Sequence of Post-crushing Sample Processing Procedures

There are three general sample processing procedures that may be performed after sample crushing. These include:

a) Sample size reduction—procedure to obtain a smaller volume of test material while attempting to keep the degree of representativeness of the original sample intact.
b) Homogenization—blending of diverse rock and soil particles into a uniform mixture so that a representative sample may be obtained. This procedure is not included in M435, but is a recommended processing activity that will increase the accuracy and repeatability of the analytical results.
c) Pulverization—sample particle diminution to ensure that the resulting powder can be examined under the microscope, using PLM.

The sequence in which these post-crushing procedures are done to prepare the sample for analysis greatly affects the representativeness of the material that will be analyzed by the microscopist. As written in M435, the sequence of post-crushing sample preparation procedures is as follows:

a) Reduce volume of crushed sample to a one pint aliquot (ASTM Method C-702 80).
b) Further crush (pulverize) the one pint aliquot using a Braun mill or equivalent to produce a material of which the majority is less than 200 Tyler mesh (less than 75 micrometers).

ASTM C-702-80, "Standard Practice for Reducing Field Samples of Aggregate to Testing Size," is included in M435 as a reference method to reduce a large field sample to a convenient size for conducting the test. This method is performed in a manner so that the smaller portion, which will be further pulverized and then analyzed, is likely to be representative of the field sample. For dry aggregates, the ASTM-preferred method for size reduction is the mechanical splitter (riffle splitter), which divides the sample into two halves.

ASTM C-702-80 further states that when the test is for certain contaminants that occur as a few discrete fragments in only small percentages, as is usually the case with NOA in aggregate samples, the entire field sample should be tested. ASTM C-702-80 states that caution should be used in interpreting the results from analysis of a reduced size test sample. Because of this, ARB staff encourages laboratories, if at all possible, to avoid sample size reduction immediately after the crushing procedure. This guidance document will discuss sample size reduction in greater detail in Section IV.7.

Because laboratory processing equipment (and the associated specifications) vary, there is no "one size fits all" post-crushing procedure that staff can recommend. Although one sequence may be deemed more advantageous than another, the presence of certain laboratory processing equipment largely determines the order in which processing steps may be done.

That said, there may be value in considering the addition of a homogenization step that will greatly increase sample representativeness and will lead to more accurate and repeatable analytical results. Homogenization is discussed in more detail in Section IV.6.

The following table (Table 1) shows some recommended post-crushing processing sequences. As a baseline, the M435 post-crushing sequence of sample preparation is shown in the bottom row of Table 1. The potential changes to this post-crushing sequence are shown in the rows above. ARB staff's discussions on homogenization enhancements are based on available laboratory equipment.

Going from top to bottom of Table 1, the most recommended order sequence of post-crushing activities (i.e., pulverization, homogenization, sample size reduction) depends on whether a laboratory has a Braun mill and a large-capacity mixer. The Braun mill (also known as plate grinder) can pulverize the entire crushed sample in a reasonable amount of time. Using this equipment, pulverization of a two-quart (approximately two-liter) crushed field sample should take less than 15 minutes. This processing sequence also depends on whether the laboratory has a large-capacity (four-quart or approximately four-liter) sample homogenizer. The potential post-crushing sequences are shown in Table 1 and discussed below.

Available equipment: Braun mill and mixer with four-quart (approximately four-liter) capacity
Sequence 1: crush--pulverize--homogenize--obtain one pint (approximately 0.5 liter) for test

This is the recommended sequence if the laboratory can quickly pulverize the crushed sample and has a large-capacity mixer. The entire crushed sample is pulverized, and then homogenized. After homogenization, a one-pint (approximately 0.5-liter) test sample can be obtained for M435 analysis even without passing the powder through a riffle splitter. The powdered sample is homogenized at this point and the use of a riffle splitter to obtain a smaller-volume test sample is no longer needed.

Available equipment: Braun mill (no large-capacity mixer)
Sequence 2: crush--pulverize--manually homogenize--obtain 1 pint for test

In this sequence, the presence of a Braun mill that can pulverize the entire crushed sample allows the inclusion of all materials in the pulverization and manual mixing (homogenization) may be done by agitating the closed container or churning the powder with a disposable spatula. After this, a one-pint (approximately 0.5-liter) test sample can be obtained for M435 analysis.

Available equipment: shatterbox (SB), ball mill (BM), or freezer mill (FM) and large-capacity mixer
Sequence 3: crush--homogenize--manually reduce sample size--pulverize

The crushed sample is first homogenized. One pint is manually obtained from the mixed crushed sample and then pulverized for M435 analysis. The representativeness of the sample portion that is pulverized depends on how well the crushed material was homogenized prior to sample size reduction.

Table 1. Recommended Post-crushing Sample Processing Sequences

Available Post-crushing Equipment	**Step 1**	**Step 2**	**Step 3**
Braun Mill + Mixer (Sequence 1)	Pulverize entire crushed sample.	Use mixer to homogenize entire powdered sample.	Manually take 1 pint for analysis.
Braun Mill (no Mixer) (Sequence 2)	Pulverize entire crushed sample.	Manually homogenize powdered sample.	Manually take 1 pint for analysis.
Shatterbox (SB), Ball Mill (BM), or Freezer Mill (FM) + Mixer (Sequence 3)	Use mixer to homogenize entire crushed sample.	Manually take 1 pint crushed sample for pulverization.	Pulverize 1 pint crushed sample for analysis.
SB, BM, or FM (no Mixer) (Sequence 4)	Riffle split entire crushed sample and take 1 pint aliquot.	Pulverize 1 pint crushed sample.	Manually homogenize powdered sample for analysis.
M435: Braun Mill or Equivalent (no Mixer)	Riffle split entire crushed sample and take 1 pint aliquot.	Pulverize 1 pint crushed sample for analysis.	

Available equipment: SB, BM, or FM (no large-capacity mixer)
Sequence 4: crush--reduce sample size--pulverize--homogenize or mix

If the laboratory has a small-capacity pulverizer and has no large-capacity mixer, then the entire crushed sample should be repeatedly poured through a mechanical splitter (i.e., riffle splitter), and the sample size is reduced to a one-pint (approximately 0.5-liter) aliquot. This pint of crushed material is pulverized. The powdered sample is then mixed using a smaller-capacity homogenizer, if available, or manually mixed, and then analyzed.

Of the four sequences, all provide some enhancements to what is stated in M435. Under normal conditions, Sequence 1 reflects staff's most recommended post-crushing sequence in obtaining a representative subsample for analysis.

IV.5 Pulverization

M435 requires that the majority of the particles in the pulverized sample be finer than 200 Tyler mesh (less than 75 micrometers in diameter). The powder size stipulation is important because particles that are greater than 75 micrometers in diameter can be difficult to analyze by PLM due to particle thickness. In addition to meeting this M435-specific particle size distribution (PSD) criterion, staff also recommends that all laboratories strive to limit the amount of material less than 10 micrometers in diameter (an indicator of over-pulverization). They should also limit the amount of material greater than two millimeters in diameter (an indicator of incomplete pulverization).

The recommended PSD would be one where:

a) At least 98 percent of the pulverized material passes through the 250-micrometer mesh sieve.
b) The 75- to 250-micrometer fraction is between 40 to 50 percent of the total mass of the sample processed.
c) The less than 75-micrometer fraction is between 50 to 60 percent of the initial sample mass.

The particle size distribution recommended above is intended to reduce the risk of overgrinding the M435 sample so that asbestos, if present, can be identified using PLM.

<u>Equipment</u>

M435 states that the crushed sample shall be pulverized using the Braun mill (Figure 6), or an equivalent pulverizer. The method leaves it up to laboratory personnel to determine what is equivalent to the Braun Mill. Pulverization equipment should be operated in strict compliance with lockout/tagout and other safety procedures, as appropriate.

The only explicitly stated performance criterion specified in M435 pertaining to pulverizing equipment is that the majority of the powdered material produced must pass through a 200 Tyler mesh (i.e., less than 75 micrometers in diameter). The ARB-led ILS (Appendix B) showed that even though all the equipment reviewed satisfied this one performance objective, the laboratory equipment and procedures employed affected the particle sizes of the sample powder produced, and in one case, the amount of asbestos content detected and reported. Therefore, staff recommends additional performance objectives as described in this section.

Figure 6. Braun Mill*

*Also known as a disc pulverizer or plate grinder

The M435 ILS (Appendix B) was performed to assess the variable sample processing and analytical procedures used by laboratories and whether these differences affect the reported asbestos content. During the ILS, staff observed that in addition to the Braun mill, other pulverization equipment used by laboratories include the vibrating pulverizer (shatter box), freezer mill, and ball mill. See Figure 7.

Figure 7. A. Vibrating Pulverizer (Shatter Box); B. Freezer Mill; C. Ball Mill

A. B. C.

The ILS showed that there were visible differences in the pulverized rock powder processed using the above four pulverizing equipment, as shown in Figure 8. A subsequent quantitative PSD analysis was performed and illustrated in detail in Figure B-8 (Appendix B). This guidance document will not identify which powder was made by which pulverizer, except that produced by the Braun mill (plate grinder). This is because the laboratories had participated in the ILS under conditions of anonymity and it was well known at that time which laboratory used certain pulverizing equipment. However, the following results can be provided:

a) All four pulverizers met the M435 criterion of producing a powder where the majority of particles are less than 75 micrometers in diameter.
b) Powders 3 and 4 (Figure 8) showed remaining chunks of rock material (incomplete pulverization). Rock chunks cannot be mounted on a slide for subsequent analysis by PLM.
c) Nearly 50 percent of the particles from powder 2 were less than 10 micrometers (defined here as over-pulverization); these particles were very difficult to analyze at 100X magnification, as stipulated in M435. They are near the resolving limit of the light microscope as used in M435 and are difficult to visualize under PLM.
d) M435 analysis of powder 2 samples during the study resulted in statistically significant less asbestos reported than powders produced from other equipment.
e) The pulverized powder 1 was prepared using the Braun mill, met the M435 criterion, did not leave leftover chunks, and was not over-pulverized.

More generally, the Braun mill also has the ability to pulverize two to three quarts (approximately two to three liters) of dry, crushed rock material in 15 minutes or less. Furthermore, the Braun mill can be calibrated to consistently avoid incomplete and over-pulverization. These results and capabilities support the use of the Braun mill for pulverization.

Figure 8. M435 Interlaboratory Study Sample Powders

Powder 1 Powder 2 Powder 3 Powder 4

M435 allows equivalent pulverizers to be used which could include the equipment shown in Figure 7 and potentially other types of pulverizers. ARB staff recommends that laboratories show equivalency of these other pulverizing equipment to the Braun mill, in terms of particle size distribution and length of time and efficiency of pulverization, and be able to provide appropriate documentation upon request. Pulverization protocols should be developed that result in acceptable PSD (per M435) of the powder produced and equivalent size characteristics to a powder processed using the Braun mill. This may be done by calibrating the duration of pulverization when using these other equipment. Such duration would vary when pulverizing soft rocks or hard rocks.

Pulverization Using the Braun Mill

The reduction of rocks and soils to a fine powder using the Braun mill is done by adjusting the distance between the grinding plates. Figure 9 shows the grinding plates separated on the left, over which a metal hood is mounted and locked when the equipment is in use.

Figure 9. Inside the Braun Mill

The Braun mill should be operated in strict compliance with lockout/tagout and other safety procedures, as appropriate. (See reference section for OSHA Lockout/Tagout Fact Sheet [2002]). The Braun mill should be adequately cleaned prior to use. All of the following activities for pulverization should be performed under a negative air fume hood enclosure with a minimum flow rate of 100 feet per minute (approximately 30.5 meters per minute) and using a HEPA filter. The procedure for pulverization is not explicitly discussed in M435, but the recommended procedure is as follows:

a) Set the plates to barely touching each other, and slowly back off to increase their distance of separation to 0.10 millimeter. Using a metric calibrated metal feeler gauge, measure this distance between the two plates at several locations to make sure that the plates are parallel and that the distance of separation is uniform throughout. The suggested plate separation of 0.10 millimeter may be adjusted, depending on how parallel the plates are mounted and the results of the PSD determination. It is important to calibrate the plate distance used for each plate grinder as this plate distance will affect the PSD of the powder produced.
b) Gradually feed the 3/8-inch (about 0.95-centimeter) crushed material through the sample intake.
c) After pulverization, collect the powdered material in the pan. Make sure to gradually cover the pan with a plastic sleeve as the pan is extracted from the plate grinder to prevent airborne dust.
d) After pulverization, clean the plate grinder by purging (grinding) non-asbestos material, brushing, vacuuming, and wiping down the plates and the entire equipment. Appendix F provides a recommended cleaning protocol for the

plate grinder. This cleaning protocol was developed after testing by ARB staff using high-concentration asbestos samples.

IV.6 Homogenization

A procedure for homogenization is not addressed in M435. However, ARB staff believes that this is one of the most significant sample processing enhancements a laboratory can make.

ARB staff has observed that pulverization with a Braun mill results in a heterogeneous powder, where the first materials that enter the sample intake are the first to go out through the plates and exit into the collecting pan. While pulverizers that use impaction for particle size diminution (i.e., shatter box, freezer mill, ball mill, etc.) may do a better job of mixing the powder during pulverization, these equipment are not purposely used to homogenize the powdered sample.

The addition of a mixing procedure in M435 sample processing would greatly increase homogeneity of the pulverized material before an aliquot of powder is taken for analysis. This procedure would increase the likelihood that the aliquot is representative of the field sample, as well as increase the accuracy and repeatability of the analytical results.

ARB staff recommends the use of a three-dimensional (3-D) mixer (e.g., 88 Mixer System Schatz Model 4 (1A)) which mixes the sample in three dimensions using Schatz inversion-kinematic movement. (See Figure 10.) Staff's literature search and laboratory testing of the Schatz 3-D mixer showed that it produces a highly homogenized powder in a short amount of time (approximately 5 to10 minutes). In addition, multiple designs are available to handle increasing sample sizes, easily large enough to handle M435 samples. The removable sample container makes cleaning relatively easy.

Figure 10. Three-dimensional Mixer - 88 Mixer System Schatz Model 4 (1A)

For purposes of M435 processing, it is recommended that the pulverized sample be homogenized with the 3-D mixer at 40 revolutions per minute for 10 minutes to ensure thorough mixing. Other mixing equipment (e.g., V-blender, rotary mixer, etc.) may be suitable for homogenization, but the optimal mixing procedures for each of these equipment would need to be determined by the laboratory. Results of an ARB study showing the advantages of homogenizing the sample are shown in Appendix G.

IV.7 Sample Size Reduction

As specified in M435, sample size reduction is done to reduce the amount of the crushed sample prior to pulverization. However, as indicated in Section IV.4 of this guidance document, there may be instances when this step may not be needed, based on available laboratory processing equipment. When a laboratory can easily pulverize a two- to three-quart volume (approximately two to three liters) of crushed rock sample then there is no need to reduce the sample volume immediately after crushing. Following the homogenization of the powder product, this allows for a more representative powder to be analyzed at the microscope. For those laboratories that need to follow the sample size reduction step, further clarification and guidance is provided below.

For guidance on reducing sample size, ASTM Method C-702-80 is referenced in M435 and the applicable procedures (Methods A and B) for reducing sample size are discussed at length. ARB staff recommends Method A—Mechanical Splitter (Figure 11) because it is deemed more accurate (Schumacher et al., 1990).

A sample splitter is required to have an even number of equal width chutes, but not less than eight chutes for coarse aggregate, or 12 chutes for fine aggregate (ASTM Method C-702-80). The minimum width of the individual chutes should be approximately 50 percent larger than the largest particles in the sample. Two receptacles on either side of the splitter will hold the two halves of the sample after splitting. The hopper, through which the sample is introduced at a controlled rate to the splitter, should have a width equal to, or slightly less than, the total width of all the chutes. The rate at which the sample is introduced should be controlled to ensure a free flow of material through the chutes into the receptacles. Material from one receptacle is taken and the splitting procedure is repeated as necessary until a one-pint (approximately 0.5-liter) aliquot is obtained for M435 analysis.

Figure 11. Mechanical Splitter

The procedure of cone and quartering (Method B) is not preferred because it results in greater loss of fine particles than Method A (Schumacher et al., 1990), but still may be used for coarse aggregates or mixtures of coarse and fine aggregates. The material is placed on a hard surface or canvas and shoveled into a conical pile. The pile is flattened to a uniform thickness and diameter and divided into four quarters using a shovel. Two opposing quarters are taken with a scoop or shovel, mixed, and the procedure is repeated until the desired volume is obtained. ARB staff refers to the ASTM Method C-702-80 for details of this method.

V. LABORATORY SAMPLE ANALYSIS PROCEDURES

V.1 Principles (M435 Section 7)

Asbestos identification by M435 depends on the morphology and optical characteristics of the minerals analyzed. A low-magnification stereoscopic examination at 10X to 40X magnification gives the microscopist an overall view of the homogeneity of the sample and the morphology of particles. However, positive identification of asbestos can only be done with PLM, even when fibers may be observed under the stereoscopic microscope. In addition to the morphology requirements, the optical characteristics of each asbestos mineral (M435 Table 3) have to be determined and verified using PLM to complete asbestos identification.

Details of the equipment required for a stereoscopic microscope and a petrographic microscope are given in M435 Section 7.5 (Appendix A). One suggested addition to the list of equipment would be a 20X PLM microscope objective so that, together with a 10X eyepiece, the minerals may be observed at 200X magnification when assessing the optical characteristics and particle morphology. Use of a 40X objective together with the 10X eyepiece increases magnification to 400X, which would be even better for mineral identification.

The reference asbestos minerals listed in M435 may no longer be available from the listed sources. ARB staff suggests that the laboratories obtain standard reference materials from the National Institute of Standards and Technology, if available, to help microscopists review the characteristics of the six regulated asbestos.

V.2 Polarized Light Microscopy Limits of Resolution

The limit of resolution for PLM is the smallest distance between two points on a specimen that can be distinguished as separate entities. PLM resolution is determined by the microscope optics (i.e., magnification, numerical aperture) and the wavelength of light used to image the specimen (Nesse, 2004).

M435 requires a two-step approach that includes both the visualization of fibers and the verification of optical characteristics.

M435 point-counting begins with the visualization of the sample, which should be done at a magnification of 100X (M435 Appendix A) so that a larger area of the PLM slide can be considered for the M435 analysis. Therefore, although experienced microscopists have informed ARB that at 400X magnification PLM can resolve very fine particles and fibers that are at least 2 micrometers in length and at least 0.15 micrometers in thickness, the sizes of particles and fibers investigated during a M435 point-count analysis need to be considerably larger because the point-counting is done at 100X magnification.

Following the visualization of fibers, M435 asbestos identification requires the verification of asbestos morphology and optical characteristics, as described in Tables 3 and 4 of M435 (Appendix A). This can be done using PLM analysis at higher magnifications, often at 400X magnification. If asbestos fibers below the limits of PLM resolution are present in the sample, they cannot be detected and identified with the use of PLM.

Staff has observed other analytical techniques used by laboratories to identify/quantify these smaller asbestos fibers. These include X-ray diffractometry (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM).

It should be noted that other analyses, such as TEM, are not within the scope of M435 and should not be considered as part of a M435 PLM analysis. Care should be taken by the laboratory to make this clear to the client and explain why the additional analysis is not provided, unless requested by the client as an additional analytical test. However, an alternative analytical method may be used as long as it produces results substantially equivalent to the results produced by the point-counting method and is approved by the Executive Officer of the Air Resources Board.

XRD is an analytical technique that can identify minerals through the constructive interference of monochromatic X-rays that are diffracted by a crystalline sample. However, XRD is a bulk analytical method that in its standard form is typically used when the mineral of interest has a concentration in excess of 5 percent by weight of the total sample mass. In contrast, M435 has a sensitivity of 0.25 percent by point-count. Therefore, XRD, as it is commonly used for bulk analysis, would not be a sensitive technique to verify non-detect M435 PLM results.

While SEM may be used to characterize the morphology and elemental composition of particles, it does not provide information on crystallographic characteristics that should be used to identify the asbestos mineral, as described in Table 3 of M435 (Appendix A). Therefore, SEM alone is not sufficient for asbestos verification.

ARB staff is aware that some regulatory agencies complement PLM analysis with TEM. Samples are first analyzed using PLM because a much larger (and likely more representative) mass of sample powder is analyzed using PLM than when using TEM. The mass of a M435 sample analyzed by PLM is approximately one million times greater than the mass of a TEM sample, but TEM has a resolving power of 500 to 20,000X magnification (compared to 50 to 1000X magnification by PLM). This higher resolving power enables TEM microscopists to distinguish and identify finer particles and fibers not seen with the use of PLM. For example, the California Department of Toxic Substances Control has used PLM, followed by TEM, as part of a tiered analytical approach to verify the absence of asbestos fibers determined by M435 PLM analyses in its Schools Program.

V.3 Procedures for Quantification of Asbestos Content (M435 Section 8)

Testing Volume

Per M435, the material to be analyzed shall be the one pint aliquot of pulverized material for the assessment of asbestos content (M435 Section 8.1, Appendix A). M435 does not state a given volume or mass of powdered material that should be mounted separately on each glass slide. After repeatedly observing microscopists perform this procedure, ARB staff recommends that approximately five milligrams of powdered sample material be used for each PLM slide (total of 40 milligrams for eight slides). This would standardize the amount of powder analyzed per sample, taking care to use enough material so that the particle loading is approximately 30 percent in the field of view (FOV), thereby minimizing particle overlap. Forceps or scalpels should be used to take the powder from different locations throughout the pint aliquot. Also, a coring device (i.e., disposable hollow tube) may be used to obtain material from the interior of a powdered sample. A detailed discussion on representative laboratory subsampling of particulate laboratory samples can be found in the document EPA/600/R-03/02 (2003), Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (link provided in references section).

Fiber Identification

Fiber identification by M435 requires that the asbestos fibers have a length-to-width aspect ratio of at least three-to-one (3:1) and positive identification of morphological and optical characteristics listed in Table 3 of M435-(i.e., color, pleochroism, refractive indices, birefringence, extinction characteristics, and sign of elongation).

The asbestos criterion of a minimum length-to-width aspect ratio of 3:1 is only the beginning in a series of tests on the morphological and optical characteristics that need to be met before a fiber is identified as “asbestos.” Through a series of verifications on the optical characteristics enumerated above, one is able to identify asbestos. However, despite these asbestos identification tables, the wide range of asbestos fibers counted from asbestos-spiked samples from the ARB ILS suggests that laboratories use different identification criteria for asbestos. It should be stressed that only the asbestos characteristics, as described in Table 3 and Table 4 of M435 (Appendix A), should be used for determination of what is asbestos.

Attempts to disqualify suspect asbestos fibers using criteria outside of what is described in Table 3 of M435 for morphology or optical characteristics, as may be expected from asbestos-containing materials (ACMs), are discouraged. NOA may not always exhibit the unweathered characteristics of asbestos more often found in ACMs due to the added matrix materials. For purposes of asbestos identification using M435 analysis, ARB staff recommends that fibers which meet the morphological and optical characteristics of one of the six asbestos types, as defined in Table 3 of M435, be reported as asbestos; otherwise, the reported analysis by the laboratory is not considered a M435 analysis.

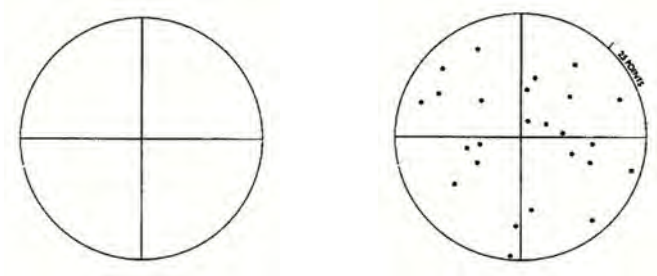
Asbestos Quantification

The laboratory is given the option to use a 100- or 25-point Chalkley array in the microscope eyepiece or a standard crosshair eyepiece. Among several asbestos laboratories visited by ARB staff, none were observed to use a 100-point Chalkley array.

As described in Section 8.3 of M435, a total of 400 particles are counted over at least eight slide preparations containing representative sample powder mounted in the appropriate refractive liquid. Fifty particles are counted in each of the eight slides and analyzed at 100X magnification. For example, when using a standard single crosshair reticle (Figure 12, left), the reticle is randomly moved across the slide. When the crosshair lands on a particle, its morphological and optical characteristics are analyzed to determine whether that particle is a fiber that is asbestos. By moving the crosshair to 50 different locations, ideally using a mechanical stage, a large portion of the slide is examined and individual particles are tested during the quantification procedure.

In contrast to this, the 25-point Chalkley array (Figure 12, right) is superimposed on a portion of the slide. All particles that land under a point are part of the point-count. However, to do a proper M435 analysis, each fiber suspected to be asbestos needs to be examined under the crosshair and the optical properties verified using Table 3 of M435. In the process of moving the 25-point reticle and examining a suspect fiber under the crosshair, a microscopist can lose track of other particles, originally under a point, in the FOV. Some microscopists work around this problem by assuming that other suspect fibers they may have observed in the FOV under a point are the same mineral as the suspect fiber that they examined and verified. Other microscopists perform an initial scan of the PLM slide to determine if suspect fibers are asbestos. Then they proceed to point-counting and assume that other suspect fibers they may notice during the point-count are the same minerals as the ones they had initially verified. In both cases, each suspect fiber may not go through the formal optical characteristics verification in the course of point-counting with the 25-point reticle.

Figure 12. Single Crosshair (left) and 25-point Chalkley Array Reticles (right)



Another detriment of using a 25-point reticle is that a smaller portion of the slide is analyzed under the microscope. For instance, if all of the 25 points of the reticle land on a particle, it is possible that the 25-point reticle may be used to count particles only in two FOVs of the slide. In this case, the majority of the sample powder mounted on the PLM slide will not be examined.

Staff recommends the use of a standard crosshair reticle for point-counting. This technique has two distinct advantages over the 25-point reticle:

a) A larger area of the slide is viewed during the 50 particle point-count (per slide).
b) It allows the microscopist to verify the optical characteristics of each suspect fiber that falls under the crosshair without losing track of the other particles already counted.

Staff also recommends that although the quantitation is done at 100X magnification, the microscopist should have a 20X PLM objective, allowing for 200X magnification when verifying the optical characteristics of each fiber.

Per M435, it is required that even if one asbestos mineral is confirmed, the microscopist should continue the analysis and verify the presence of other asbestos minerals (M435 Section 8.1, Appendix A) using the other appropriate refractive index liquids.

The calculations for percent asbestos using point-counting are based on an assessment of 50 particles in each of eight PLM slides for a total of 400 particles per M435 sample. Some laboratories attempt to increase the sensitivity of the test by counting more particles (e.g., 1,000 particles). ARB staff supports assessing more than 400 points only if the increase in points is done in multiples of 400 (e.g., 800, 1,200, 1,600, etc.). Otherwise, the additional point-counting may have an unintended negative effect by increasing the number of Type II (false negative) errors. An explanation of this is provided in Appendix H.

V.4 Procedures for Exceptions (M435 Section 8.3)

M435 describes two situations where an exception for the required point-count analysis may be granted.

Exception I is possible when a sample is suspected to contain no asbestos. Three PLM slides are prepared and 10 FOVs per slide are observed under PLM. Optical characteristics listed in M435 Section 8.2 must be determined to positively identify asbestos. When no asbestos fibers are observed from 30 FOVs, it can be reported that no asbestos was found using the visual technique of analysis.

Exception II is possible when a sample is suspected to contain asbestos in excess of 10 percent. Three PLM slides are prepared and if the asbestos content is estimated to exceed 10 percent by visual technique, then the particle point-count will not be necessary. It can be reported that the asbestos content exceeds 10 percent using the visual technique of analysis.

Using the visual technique, microscopists familiarize themselves with charts that show known areal percentages of asbestos fibers observed within a matrix of other particles. By repeatedly comparing what is observed under the microscope with charts of known percentages, a microscopist may be able to visually estimate the percentage of asbestos in a sample.

However, if one or more asbestos fiber(s) are identified from 30 FOVs in the three PLM slides prepared, or the asbestos content is estimated by visual technique to be less than 10 percent, then the analyst is required to continue with the point-counting procedure using an additional five slides or more, for a total of at least eight PLM slides.

VI. QUALITY CONTROL (QC)

Through a method review and consultations with geologists and asbestos laboratories, staff has identified additional field sampling and laboratory analysis QC practices and principles applicable to M435. Beginning with field sampling, laboratory processing, and analysis, the QC measures summarized in this section build upon related recommendations that may be discussed elsewhere in this document. While many of these QC practices are not addressed in M435, their use would increase the likelihood of obtaining more accurate and repeatable M435 results.

VI.1 Sampling QC

Maintenance of equipment cleanliness during sampling is of primary importance, particularly when using field equipment such as sampling tubes, augers, and shovels. A written protocol for equipment cleaning and storage procedures in between collection of samples should be developed and followed.

Every effort should be taken to maintain the integrity of field samples. It is recommended that field samples be double-bagged using reclosable sample bags that are at least 4/1,000 inch (4 mil) thick (101.6 micrometers) to avoid sample spillage. In case the first sample container is breached, the sample will still be held intact by the second sample container.

Sample identity can be protected by placing a sample identification tag inside the sample container and, at the same time, using a permanent marker to write the sample name outside the sample container.

It is good practice for sampling personnel to maintain an ongoing list of M435 samples while in the field. Details on the field sample list should include at least the information required for the sample log, as enumerated in Section III.4 of this document.

Records of activities for planning and conducting field collection of M435 samples should be complete and safely stored. These include, but are not limited to, the approved sampling plan, sampling methodology, sample log, and the field sampling report. A CoC, beginning with sample collection, should be made and maintained when samples are submitted to the laboratory for analysis.

VI.2 Processing QC

Although sample processing QC is not addressed in M435, the following are recommended QC practices for the laboratory processing of field samples.

Chain of Custody

As detailed in Section IV.1, a sample chain of custody should be initiated by the field sampling personnel and continued upon receipt of the samples by the laboratory. Criteria should be identified to determine if there are any inadmissible M435 samples. A laboratory information management system can efficiently track not only the physical location of a sample in the laboratory, but also information on who performed which test on each of the samples.

Detailed M435 Standard Operating Procedure (SOP)

Each laboratory that performs M435 analysis should have a written SOP specific for M435. This includes all equipment and procedures that the laboratory uses for M435 sample processing and analysis. This SOP should also be used for laboratory training of technicians for M435 sample processing and microscopists for M435 sample analysis. This M435 SOP should be readily available to each technician or microscopist during M435 sample preparation and analysis. The SOP should also be made available to local air districts or ARB staff upon request.

Equipment Cleaning Protocols

Rigorous equipment cleaning protocols should be written for the equipment used in processing the M435 samples. Examples of cleaning protocols that were tested by ARB staff for the crusher and the plate grinder are given in Appendix E and Appendix F, respectively. Included in the protocols is the use of equipment cleaning purges (blanks) to make sure that no asbestos is detected from asbestos-free samples that are processed through the clean equipment.

Blanks

Processing blanks, consisting of materials tested and found to have no asbestos, should be processed alongside regular field samples. These processing blanks, when analyzed blind, should yield negative results for asbestos. There should be a minimum of one processing blank for each job site to verify that no sample cross-contamination has occurred during processing. If a processing blank yields a positive result for asbestos, then sample processing should be halted. Processing procedures should be reviewed, amended, and re-tested to ensure that there is no cross-contamination of samples. One suggestion would be to ensure that at least one processing blank is produced and verified to not contain asbestos before processing samples from a new job site.

Calibrations

Calibration of processing equipment should be done to make sure that the sample powder produced meets the PSD requirements for M435 analysis by PLM. When using a Braun mill (plate grinder), the gap between the two plates can be adjusted to approximately 0.1-millimeter distance. When using other pulverization equipment (e.g., freezer mill, shatter box, ball mill), the duration of the impaction can be adjusted to result in a finer or coarser grind.

Sample Processing Calibration Check

A particle size calibration check can be done to make sure that the powder produced after grinding is acceptable for M435 analysis by PLM (i.e., majority of particles are less than 75 micrometers in diameter). To do this sieve test, approximately 30 milliliters of powdered sample can be weighed and sieved through a covered stack of a 250-micrometer mesh sieve, over a 75-micrometer mesh sieve, over a bottom pan (see Figure 13).

Figure 13. Stack of Sieves for Particle Size Check

This PSD would indicate that the powder can be analyzed by PLM (10-75 micrometer particle diameter) and that the sample is not over-pulverized beyond the resolving power of a light microscope. Equipment or duration time should be adjusted accordingly if the sieve test is not met.

VI.3 Analysis QC

Section 8.3 of M435 (Appendix A) states the need for analyst cross-checks, where a second microscopist analyzes one in 10 samples of those analyzed by the first microscopist. This is done to verify and confirm the quantitation result. This is an important, common QC check. However, staff recommends the implementation of other analytical QC measures. These additions are briefly discussed below.

Microscope Alignment / Calibration of Refractive Index Liquids

Before any analysis is done, microscope alignment should be done every day and calibration of refractive index liquids should be done every three months (New York State Environmental Laboratory Approval Program Certification Manual, Method 198.6 (2016)).

Training

Microscopists should be trained to recognize asbestos morphology and determine optical characteristics of asbestos. The asbestos proficiency training should include analysis of not only the six forms of asbestos identified as TAC, but also the non-asbestos fibrous minerals that may be mistaken for asbestos (asbestos interferences). Microscopists who have analytical experience would still benefit from routine analysis of asbestos performance evaluation samples to refresh their familiarization with the six regulated asbestos. Staff recommends performing routine analyses of performance evaluation samples as part of the microscopists' weekly review of fixed slides of asbestos standard reference materials and asbestos interference minerals. See Appendix J, Recommended Training and Experience for Asbestos PLM Analysts.

Replicates

Blind analytical replicates of the same sample are recommended at a frequency of at least one in every 20 samples. Results of the primary and replicate analyses should match (i.e., either both analyses detect asbestos greater than or equal to 0.25 percent concentration, or both result in non-detect for asbestos). If replicate analyses do not match, the quality assurance (QA) supervisor or laboratory manager should determine the reason for the difference and ensure that an appropriate control action is taken. All results and any corrective actions should be documented.

Instrument Cross Checks

Instrument cross checks, include analyzing the same sample on different microscopes by the same microscopist, should be done periodically (e.g., every 20 analyses). The results of these cross checks should match. If they do not, the reason for the difference should be identified and the appropriate control action implemented and documented.

Method Validation

Method validation tests the ability of the laboratory to correctly process M435 samples and accurately detect asbestos when present. If not already performed and documented, the laboratory should perform a method validation study for M435. Using a set of performance evaluation (PE) samples (i.e., asbestos-containing and asbestos-free M435 PE samples), each laboratory can test their M435 SOP to make sure that asbestos is consistently detected when present in PE samples as well as to avoid false asbestos identifications.

Documentations

Documentation of analytical results is important and preferably done with a laboratory information management system (LIMS). The data recorded should include all bench analysis information such as the sample description using a stereoscopic microscope and crystallographic characteristics used to identify or rule out suspect fibers. Proof of the identification criteria (e.g., micrographs showing particle morphology, particles' refractive indices, birefringence, optical sign, etc.) should be recorded and saved in the LIMS. Clients should be informed of the option for photomicrographs of fibers identified as asbestos in their samples, for an additional cost. All type(s) of asbestos observed to be present should be identified and reported.

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VIII. APPENDIXES

Appendixes A through J are on the following pages.

Appendix B

ARB Test Method 435 Interlaboratory Study

INTRODUCTION

Background

In 2005, concerns were raised by stakeholders regarding the repeatability of analytical results from the California Air Resources Board's (ARB) Test Method 435 (M435), "Determination of Asbestos Content of Serpentine Aggregate." Stakeholders stated that laboratories prepare and analyze soil and rock samples in different ways and obtain differing results from the same, or similar, samples.

To address these concerns, ARB staff met with M435 stakeholders, including commercial laboratory personnel, and decided to conduct an interlaboratory study (ILS) that compares laboratory sample processing and analysis procedures. The ILS was completed in July 2007. ILS results were first shared with the participating laboratories in August 2007 and subsequently shared with other stakeholders in various meetings and workshops.

Purpose

The purpose of the ILS was to investigate sources of variability among laboratories during M435 sample processing and analysis and determine whether these differences can affect M435 analytical results.

PARTICIPANTS

ARB staff coordinated the ILS. Four commercial laboratories, all offering M435 analytical services in California and located within 100 miles (160 km) of ARB offices in Sacramento, participated in the ILS. All four laboratories were accredited by the National Institute of Standards of Technology (NIST) through the National Voluntary Laboratory Accreditation Program for polarized light microscopy (PLM) analysis as a bulk test for asbestos-containing materials (ACMs) using the 1982 procedure, EPA-600-M4-82-020, "Interim Method for the Determination of Asbestos in Bulk Insulation Samples." The four participating laboratories included:

1) Asbestos TEM Laboratories, Inc.--Berkeley.
2) EMSL Analytical, Inc.--San Leandro.
3) Forensic Analytical Laboratories, Inc.--Hayward.
4) RJ Lee Group, Inc.--San Leandro.

The laboratories agreed to participate in the ILS under conditions of anonymity such that the results of the study would not be directly attributed to any laboratory.

STUDY DESIGN

The ILS was conducted in two phases. During Phase One, laboratory pulverization and analysis of a crushed field sample were observed. During Phase Two, fixed mounted slides, prepared by ARB staff, were given to laboratories for analysis in a round robin study to further assess analytical practices. The two phases of the ILS are described separately in this appendix. For each phase, the general focus was on the variability of the results rather than evaluating for accuracy. In Phase One, asbestos was highly suspected to be present in the sample. In Phase Two, asbestos was known to be present in those samples that were spiked with an asbestos standard reference material. In both cases, however, the “true” quantifiable asbestos content (by point count) was not known.

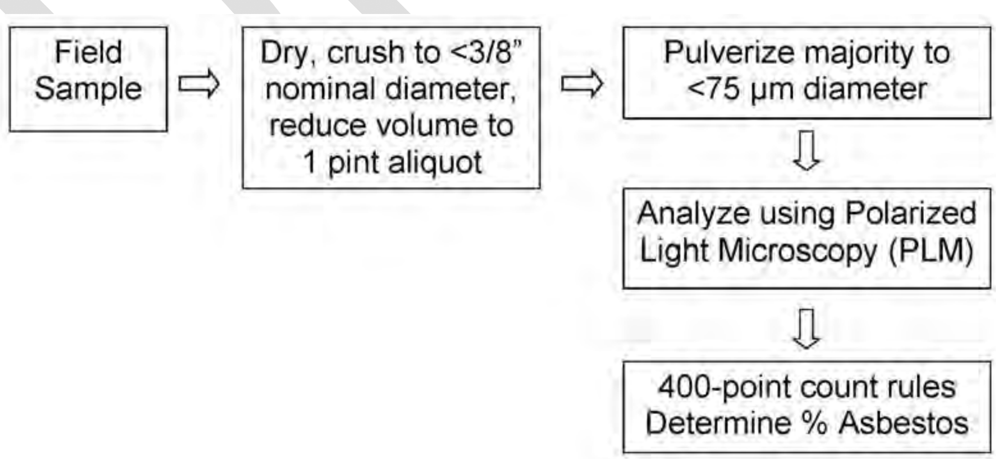
ILS Phase One

Materials and Methods

<u>Sample Preparation</u>

The sequence of sample preparation followed the requirements as set forth in M435 (Figure B-1). ARB obtained approximately five gallons (approximately 20 liters) of rocks and soil from an area where naturally-occurring asbestos (NOA) is known to be present. The rocks were observed through a stereoscopic microscope and a polarized light microscope and were found to contain fibers. ARB staff archived one gallon (approximately four liters) of the field sample. The remaining four gallons (approximately 16 liters) were prepared for the ILS.

Figure B-1. Test Method 435 Protocol



ARB staff supervised the field material preparation prior to distribution to the laboratories (Figure B-2). The sample was dried in a constant-temperature oven for

15 hours in shallow aluminum pans at 248 degrees Fahrenheit (ºF) (120 degrees Celsius, ºC). Many of the rocks were between one to six inches in diameter (2.5 to 15 centimeters). ARB staff supervised the crushing of rock samples to less than 3/8-inch (approximately 0.95-centimeter) diameter particles using a jaw crusher (Model Badger, Bico Braun International, Burbank, CA). The crushed material was repeatedly passed through a riffle splitter to randomly split and recombine several sample splits. About two gallons (approximately eight liters) of crushed sample were archived. ARB staff divided the remaining crushed sample into 1/2-gallon (approximately 2-liter) packages and labeled them for distribution to the laboratories.

Figure B-2. Sample was (A) dried, (B) crushed, (C) riffle-split, and (D) packaged.

A. Dried **B. Crushed** **C. Riffle Split** **D. Packaged**

<u>M435 Laboratory Pulverization</u>

ARB staff distributed approximately one half gallon (approximately two liters) of crushed material to each laboratory and observed each laboratory's sample pulverization procedures. Each laboratory pulverized the crushed sample according to their M435 laboratory protocol, using one of the equipment shown in Figure B-3. The laboratory

Figure B-3. Laboratory Pulverization Equipment for ILS Sample

A. Plate grinder (Braun Mill) **B. Vibratory Pulverizer (Shatter Box)** **C. Freezer Mill** **D. Ball Mill**

personnel divided their powdered product into 12 aliquots and turned them over to ARB staff. ARB staff archived a portion of the powdered product and the remaining powdered aliquots were coded and labeled by ARB staff prior to distribution to the laboratories for M435 sample analysis. Three aliquots were given to each of the participating laboratories (Table B-1).

M435 Sample Analysis

In this blind study, each laboratory was asked to analyze 12 powdered aliquots according to their M435 analysis protocol. The 12 aliquots to be analyzed consisted of three replicates of the powder processed by each of the four participating laboratories, as shown in Table B-1.

Table B-1. ILS Phase One Study Design

	Analyses by Lab A			Analyses by Lab B			Analyses by Lab C			Analyses by Lab D		
Prep by Lab A	a 1	a 2	a 3	a	a	a	a	a	a	a	a	a
Prep by Lab B	b 4	b 5	b 6	b	b	b	b	b	b	b	b	b
Prep by Lab C	c 7	c 8	c 9	c	c	c	c	c	c	c	c	c
Prep by Lab D	d 10	d 11	d 12	d	d	d	d	d	d	d	d	d

Powdered Sample Characterization

ARB staff studied and characterized the powders prepared by each laboratory. The particle size distributions (PSD) of clay (less than 2-micrometer fraction), silt (2- to 50-micrometer fraction), and sand (50- to 2000-micrometer fraction) of three aliquots, taken from the powdered product of each of the four laboratories, were determined following the pipette method (Soil Survey Staff, 1996).

Following the PSD analysis by pipette, ARB staff determined the particle size distribution of the sand fractions and the greater than 2-millimeter fraction by dry sieving. The particle size cuts are shown in Figure B-4. A known mass of oven-dry, 50-micrometer or greater diameter particles were agitated through a tared nest of 3-inch (7.62-centimeter) diameter sieves having the appropriate mesh openings. After three minutes of agitation using a sample shaker, each tared sieve was weighed under a fume hood and the mass percentage of each size fraction was calculated.

Figure B-4. Methods for Particle Size Distribution Analysis

- **Particle Size Analysis by Pipette**
  Sand 50-2000 µm
  Silt 2-50 µm
  <5 µm, <10 µm, <15 µm, <20 µm
  Clay <2 µm

- **Dry Sieving**
  50 µm, 75 µm (200 mesh)
  100 µm, 250 µm, 500 µm,
  1000 µm. 2000 µm, >2000 µm

Transmission Electron Microscopy (TEM) Sample Analysis

As a follow-up, six sample powders were submitted to two laboratories for quantitative asbestos analysis by TEM using EPA/600/R-93/116, "Method for the Determination of Asbestos in Bulk Building Materials."

Results and Discussion

M435 Analytical Results

To avoid attribution of the analytical results to any participating laboratory, Table B-2 and the following figures use letter names that have no continuity and are for discussion references only.

Table B-2. Phase One Analytical Results

	Analyses by Lab A			Analyses by Lab B			Analyses by Lab C			Analyses by Lab D		
Prep by Lab E	0.75	1.25	1.25	0.0*	0.0*	0.0*	0.75	1.00	0.75	0.00	0.00	0.00
Prep by Lab F	1.00	1.50	1.00	0.0*	0.0*	0.0*	0.25	0.50	0.50	0.00	0.00	0.00
Prep by Lab G	0.0*	0.0*	0.25	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.00	0.00	0.00
Prep by Lab H	0.75	1.00	1.50	0.0*	0.25	0.0*	0.75	0.50	1.00	0.00	0.00	0.00

Note: "0.00" is used for this table when no asbestos is detected ("0" or ND reported).
"0.0*" is used when "<0.25%" or "trace" is reported, meaning the asbestos fibers seen were not under a point.

The results of the M435 400-point count analyses among the four laboratories (each consisting of results from 12 aliquots) are shown in Table B-2 and depicted in box-whisker plots shown in Figures B-5 and B-6.

The analytical results ranged from 0 to 1.5 percent asbestos by point count (i.e., zero to six fibers reported from 400-point counts). The boxes indicate the 25th and 75th percentiles of the data and the line in the middle of the box is the median. Figure B-5 illustrates the data shown in Table B-2 grouped according to which laboratory did the pulverization. There is a notable “sample preparation effect” where there was statistically significantly less percentage asbestos content reported from the powder prepared by one laboratory. Out of all the 12 aliquots prepared by that particular laboratory and analyzed by all four laboratories, only one fiber in total was reported.

Figure B-5. Analytical Results: Sample Preparation Effect

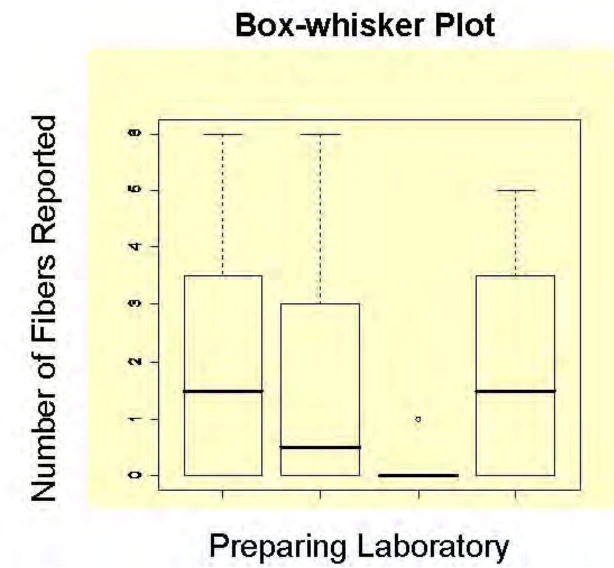
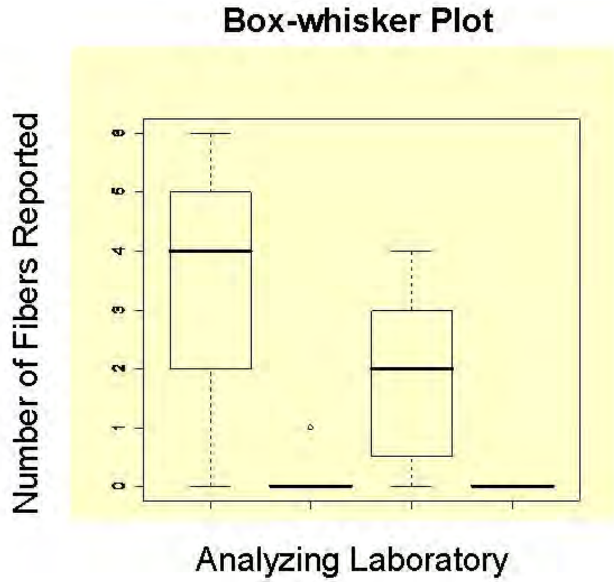


Figure B-6 depicts the same data as in Figure B-5, but this time the data are grouped according to which laboratory performed the analysis. In this case, an “analysis effect” is observed as two laboratories reported statistically significantly less percent asbestos content than the other two laboratories.

Figure B-6. Analytical Results: Laboratory Analysis Effect



<u>Powdered Sample Characterization</u>

ARB staff evaluated the characteristics of the pulverized powders after noticing visible differences among the powders produced by the laboratories. Specifically, a visual comparison of the powdered samples prepared by the four laboratories indicated that there were differences in particle sizes (Figure B-7). Powders 1 and 2 appeared to be fine-grained, and in comparison, Powders 3 and 4 had chunks of rocks, showing incomplete pulverization.

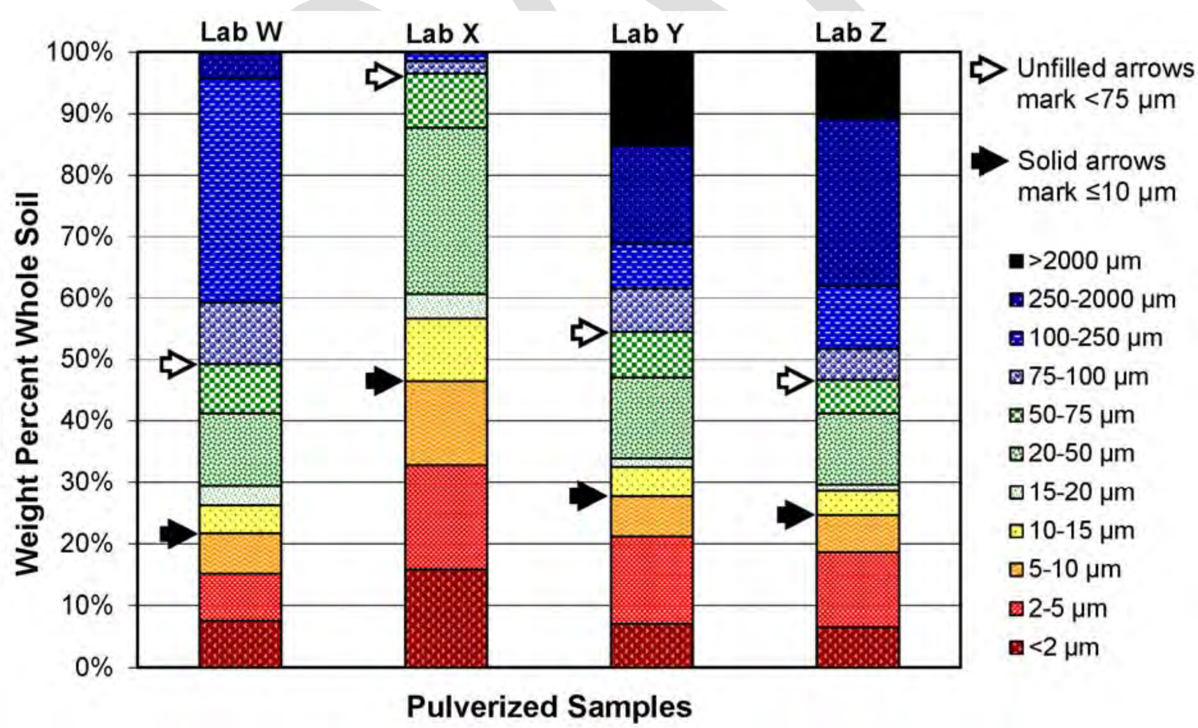
Figure B-7. Evaluation of Pulverized Samples

The analysis of the particle size distribution showed differences among the powders in the weight percentages of different particle size fractions. The particle size distribution of powders prepared by the four laboratories is shown in Figure B-8. The data presented are the averages of three replicate aliquots from each of the powders produced by the four laboratories.

Going from top to bottom, the particle sizes are graphed from coarse to fine, as is similarly shown on the legend. The solid arrows indicate the weight percent of particles that are less than or equal to 10 micrometers in diameter. The powders prepared by Laboratories W, Y, and Z have between 22 to 28 percent of particles that are less than or equal to 10 micrometers in diameter. In contrast, the powder produced by Laboratory X has approximately 47 percent of particles less than or equal to 10 micrometers in diameter. These small particles are difficult to visualize at 100X magnification using PLM, as specified for point counting in M435, but could be analyzed at much higher magnifications.

The unfilled arrows indicate the upper limit of the weight percentage of particles that are less than 75 micrometers in diameter. M435 requires that the majority of the pulverized sample must pass through 75-micrometer (200 mesh) sieve. This is also the practical upper size limit of particles that can be covered by a glass slip on an oil immersion slide of powdered material for M435 PLM analysis. Almost 97 percent of the powder produced by Laboratory X is less than 75 micrometers in diameter, whereas in the other three powders this size fraction is between 47 to 55 percent. It should also be noted that the powders produced by Laboratory Y and Laboratory Z contained incompletely pulverized rock particles denoted by the solid black size fraction of particles that are greater than 2000 micrometers in diameter.

Figure B-8. Particle Size Distribution

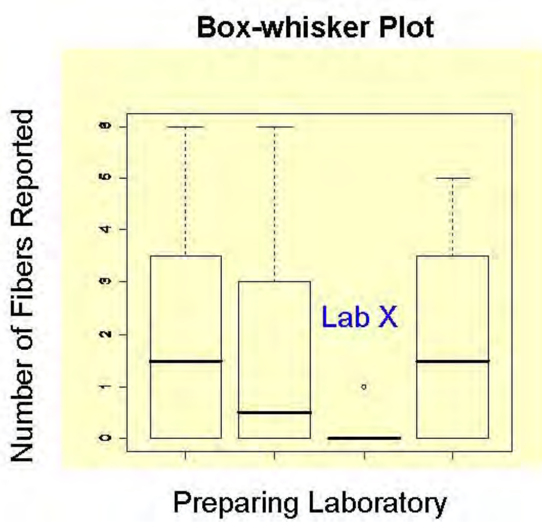


Based on the particle size analysis, it was shown that the laboratories did not produce pulverized samples with similar particle size distribution. The PSD of samples prepared by Laboratory X were much finer. Pulverized samples from Labs Y and Z contained leftover rock chunks.

Comparing the PSD of the powders shown in Figure B-8 to the analytical results depicted in Figure B-5 revealed that the powder with very fine PSD, prepared by Laboratory X, is the same powder which reportedly had the lowest asbestos content (Figure B-9). It appears that very fine PSD significantly decreases the percent asbestos reported. It is possible that asbestos, due to its needle-like shape, may be more susceptible to the pulverization process and/or the asbestos fibers may be reduced to a size smaller than can be analyzed under conditions stipulated in M435 and may even be a size smaller than the resolution of PLM.

To further investigate the presence of asbestos in the less than or equal to 10-micrometer fraction, six of the fine-grained samples pulverized by Laboratory X were sent to two laboratories for quantitative TEM analysis of asbestos content using method EPA/600/R-93/116, "Method for the Determination of Asbestos in Bulk Building Materials." Both laboratories detected amphibole asbestos in all six samples, with asbestos concentrations ranging from 0.06 to 5.3 percent by weight. These results tend to show that over-pulverization of an asbestos-containing sample may reduce the size of asbestos fibers to a point where they cannot be detected by PLM.

Figure B-9. Low Asbestos Content Reported from Over-pulverized Sample



ILS Phase Two: Analysis of Fixed Mounted Slides

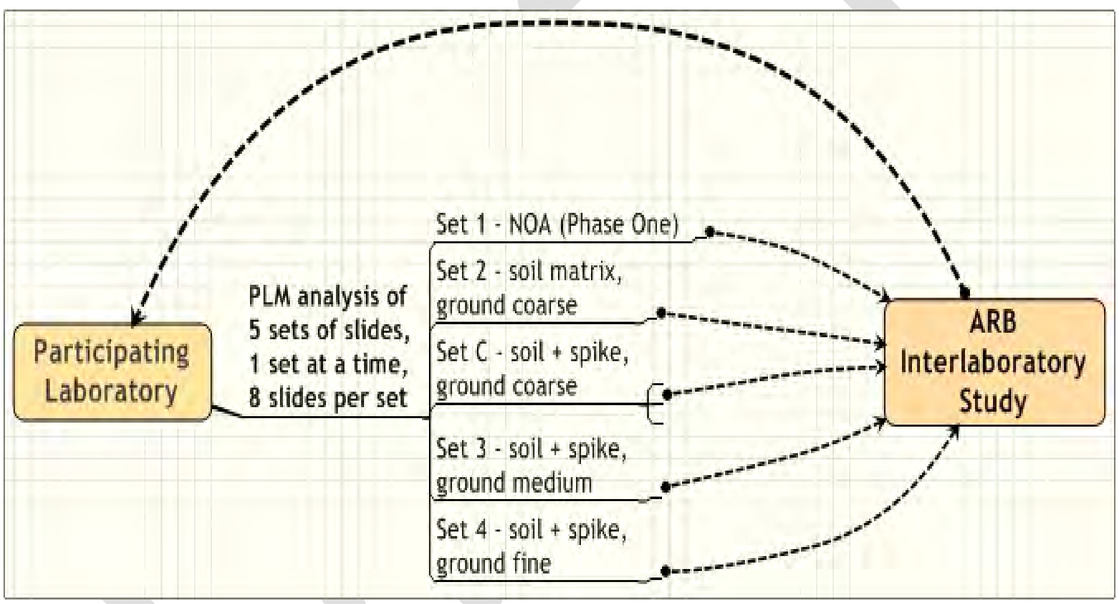
Materials and Method

ARB staff prepared fixed mounted slides of powdered material to remove the effect of sample preparation from the variability of the analytical results. Five sets of slides (Figure B-10), each set consisting of 8 slides, were prepared by permanently mounting powders from the following materials:

Set 1 NOA field sample, ILS Phase 1 sample aliquot.
Set 2 Soil matrix, ground coarse.
Set C Soil matrix spiked with 0.5 percent NIST asbestos tremolite, ground coarse.
Set 3 Soil matrix spiked with 0.5 percent NIST asbestos tremolite, ground medium.
Set 4 Soil matrix spiked with 0.5percent NIST asbestos tremolite, ground fine.

ARB staff gave one set of slides at a time to each participating laboratory. After analysis, the slides were returned to ARB staff, cleaned, and delivered to the next laboratory. (The descriptions of coarse, medium, and fine samples are given in the Pulverization Section on the following page.)

Figure B-10. ILS Phase Two: Round Robin Study of Fixed Slides



Soil Matrix Selection

Several soils from California were examined under the stereomicroscope. Oil immersion slides of these soils were evaluated for mineral components using PLM (BH-2, Olympus, Center Valley, PA). Selection criteria for choosing a soil matrix included the absence of asbestos fibers, minimal content of asbestos interference minerals (e.g., amphiboles and pyroxenes), and low content of minerals that may obscure asbestos fibers (e.g., iron(III) oxide-hydroxides, clay minerals).

The soil chosen was a coarse sandy loam from the Montpellier soil series which consists of well or moderately well drained soils formed in old alluvium from granitic rock sources, with its type location in San Joaquin County, California.

Asbestos Spike

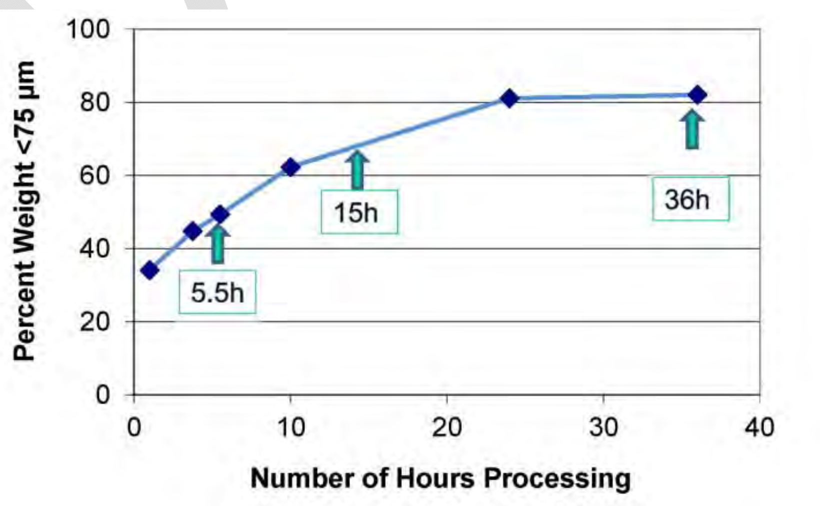
Asbestos standard reference materials (SRM) were obtained from NIST. SRM Number 1867a, Uncommon Commercial Asbestos, consisted of actinolite asbestos, anthophyllite asbestos, and tremolite asbestos. Tremolite was chosen as the spike material because it occurs in California as an asbestos mineral and is not as obvious to detect as the green, oftentimes pleiochroic, actinolite asbestos. Chrysotile, the most common asbestos in California, was also not chosen for the study because the morphology of this sheet silicate asbestos is distinctly different from the amphibole asbestos and would be very easy to identify.

Soil samples were oven-dried for 15 hours at 105 ºC, weighed, and spiked under the fume hood with the tremolite standard reference material to obtain a concentration of 0.5 percent tremolite asbestos by weight in the sample. The soil samples and tremolite were placed in cylindrical metal sample holders together with three metal grinding balls, and then labeled and double-sealed for pulverization using a ball mill, each for a specific number of hours. This was the only pulverization equipment available at the institution where the ILS fixed mounted slides were prepared.

Pulverization

Preliminary experiments were conducted on how the duration of grinding affected the percentage of the less than 75-micrometer fraction in oven-dried Montpellier soil samples that were pulverized with a ball mill. After milling, weight percentage of the less than 75-micrometer fraction was determined by dry sieving one gram of pulverized sample through a covered 75-micrometer mesh and shaking for 20 minutes. ARB staff observed an increase in the weight percentage of the less than 75-micrometer diameter particles as the grinding time increased. Based on these experiments, staff chose grinding durations of 5.5 hours, 15 hours, and 36 hours using the ball mill to obtain coarse, medium, and fine-grained samples, respectively (Figure B-11).

Figure B-11. Weight Percentage of <75-µm Particles vs. Grinding Duration



Preparation of Fixed Mounted Slides

Fixed mounted slides were prepared by an experienced laboratory technician with the guidance of ARB staff. Petropoxy 154 (Burnham Petrographics LLC, Rathdrum, ID) was the chosen mounting medium because of its well-defined refractive index (1.54) and its chemical stability. It is an epoxy-based mounting medium with low viscosity and a long shelf life.

The fixed mounted slides were prepared with particle loading of 25 to 50 percent and covered with size 1 glass cover slips (glass thickness of 0.13-0.17 millimeter). Slide identification was etched with a diamond pen on the bottom of the slide. Each set was kept in a separate box for distribution to the microscopists during the round robin study.

For the ILS Phase Two, five pulverized soil samples were used to make five sets of mounted slides, each set consisting of 10 slides. Eight slides per set were analyzed for the study and the remaining two were kept in reserve, in case replacements were needed.

Powdered Samples

For each set of fixed slides, microscopists were provided with approximately one ml of unmounted sample powder in a sealed glass vial. This gave the microscopist an opportunity to determine the asbestos optical characteristics of the same material as that mounted on the fixed slide, as indicated in M435 Table 3.

Samples and Instructions Given to Microscopists

At the beginning of each week, ARB staff gave each laboratory one set of fixed mounted slides (eight slides per set) and about one milliliter of the respective unmounted sample material. Microscopists were instructed to do a 400-point count, per M435, for each set. Analytical results were collected the same day of the following week.

Results and Discussion

Effect of Particle Size

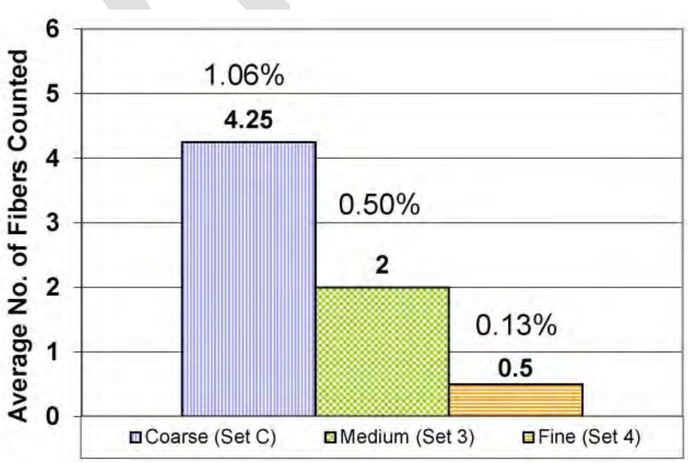
Analytical results from 400-point count of asbestos in coarse, medium, and finely-ground samples spiked with 0.5 percent tremolite showed that the average number of fibers reported decreased as the sample was ground finer (Table B-3). This was consistent with Phase One results.

Table B-3. Effect of Particle Size on Reported Asbestos from 400-Point Count

	Number of Fibers Reported				
Sample	**Lab I**	**Lab J**	**Lab K**	**Lab L**	**Observations**
Set C Coarse Spiked	**4**	**7**	**6**	**0**	Asbestos fibers reported by **three** laboratories in **coarse** sample.
Set 3 Medium Spiked	**1**	**7**	**0***	**0***	Asbestos fibers reported by **two** laboratories in **medium** sample.
Set 4 Fine Spiked	**0***	**2**	**0**	**0**	Asbestos fibers reported by **one** laboratory in **fine** sample.
	0*- indicates "trace" or "<0.25%" was reported (asbestos seen but not under a point during count).				

The average numbers of fibers reported by all four laboratories are shown in Figure B-12. Although the three samples analyzed had the same concentration of the tremolite spike, only the coarse- and medium-ground samples were reported to contain asbestos greater than 0.25 percent. If this sample was being evaluated with respect to the Asbestos Airborne Toxic Control Measure (ATCM) for Surfacing Applications that is enforceable at 0.25 percent by point count, the ATCM requirements would not be applicable for the finely-ground sample.

Figure B-12. Average Number of Fibers Reported from Coarse, Medium, and Fine Samples Spiked with 0.5% Tremolite*



*Percentage based on M435 400-point count analysis

Effect of Laboratory Asbestos Fiber Identification Criteria

ARB staff reviewed the number of asbestos fibers reported from 400-point count analyses by each laboratory during both phases of the ILS and noticed a laboratory effect first observed during the ILS Phase One (Figure B-6). The tally of asbestos fibers reported from all 400-point count analyses during both ILS phases (Table B-4) indicated that the laboratories reported a wide range in the number of asbestos fibers present in the same sample. These observations further indicated that laboratories do not have uniform asbestos fiber identification criteria.

Table B-4. Total Reported Asbestos Fibers from 400-point Counts ILS Phase One and Two

		Lab Q	Lab R	Lab S	Lab T
Phase One 400-pt count NOA	Sum of all fibers reported, 12 aliquots	1	41	24	0
Phase Two 400-pt count NIST tremolite + NOA	Sum of all fibers, Sets C, 3, 4 + Set 1, 2	6	61	5	0
	Totals	**7**	**102**	**29**	**0**

CONCLUSIONS

1. Laboratories use different M435 processing equipment and protocols. These result in varying particle size distributions of powders produced by each laboratory.

2. Although a very fine particle size distribution meets the pulverization performance requirement in M435 (majority of particles less than 75 micrometers in diameter), over-pulverization can lead to a lower percentage of asbestos reported.

3. Fiber identification criteria are not uniform among laboratories when analyzing for tremolite asbestos, which results in a wide range of asbestos concentration reported by different laboratories from M435 analysis of the same or similar samples. Although not tested, it is unlikely that this wide range of asbestos content would have been reported had the samples contained chrysotile, the more common form of asbestos in California, because of its distinctive fiber morphology.

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Appendix E

Crusher Cleaning Protocol and Rock Crushing Procedure

Operate and clean the jaw crusher under a negative air fume hood that uses a high-efficiency particulate air (HEPA) filter. Be sure that this equipment is used in strict compliance with lockout/tagout and other safety procedures, as appropriate.

Crusher Cleaning Protocol

1) Purge the crusher by introducing about 1/4 liter (about 1 cup) asbestos-free material* (e.g., white marble) into the crusher opening (Figure E-1).
2) Turn off the crusher and disconnect from electrical power. Remove the safety guard and lift out the feeder plate to clean the crusher (Figure E-2).
3) Use a vacuum cleaner equipped with a HEPA filter to clean the crusher opening and surrounding areas.
4) Use a disposable wire brush to loosen any remaining debris (Figure E-3).
5) Under a negative air fume hood enclosure with HEPA filter, use pressured air to clean the crusher.
6) Wipe down the crusher with disposable alcohol wipes (Figure E-4).
7) Clean the feeder plate using the same cleaning sequence (i.e., vacuum, brush, pressured air, alcohol wipes).
8) Change the hand gloves of the technician doing sample preparation.
9) Reinsert the feeder plate.
10) Introduce the second purge consisting of about 1/4 liter (about 1 cup) of asbestos-free material* (e.g., white marble).
11) Repeat the above cleaning procedure, taking care to use a new, clean, disposable wire brush and alcohol wipes. The cleaning procedure takes about 12-15 minutes.
12) Crusher is now ready for the next sample.

*Purging materials must have been tested by polarized light microscopy and transmission electron microscopy and shown not to contain asbestos (“blank material”). Materials used for purging during the cleaning procedures should be discarded appropriately.

Figure E-1. Purge the crusher.

Figure E-2. Lift out the feeder plate.

Figure E-3. Loosen debris with brush. **Figure E-4. Wipe down the crusher.**

Rock Crushing Procedure

a) Drop the M435 rock samples into the jaw crusher opening (Figure E-5).
b) After crushing, enclose the pan in a plastic sleeve as you remove the crushed material (Figure E-6).
c) Collect the crushed sample in a covered, temporary, clean pan or plastic container.
d) Store crushed sample under a negative air fume hood enclosure with a HEPA filter until pulverization.

Figure E-5. Drop sample into crusher. **Figure E-6. Enclose and remove pan.**

Appendix F

Plate Grinder Cleaning Protocol

Operate and clean the plate grinder under a negative air fume hood that uses a high-efficiency particulate air (HEPA) filter. Be sure that this equipment is used in strict compliance with lockout/tagout and other safety procedures, as appropriate.

1) Turn off the plate grinder and disconnect from electrical power. Slightly increase the distance between plates (Figure F-1) by loosening the locking handle (Figure F-2) and turning the distance control knob. Reconnect to electrical power and turn on the plate grinder.
2) Introduce the first purge of the grinder using two 1/4 liter scoops (about 1 cup per scoop) of oven-dried, crushed limestone* (Figure F-3) or other asbestos-free material. The powder from the first purge should be discarded appropriately.
3) Use a negative air fume hood enclosure with HEPA filter during the entire cleaning procedure. Brush the chamber interior and surrounding parts. Slam the plate cover to loosen powdered debris.
4) For all vacuum procedures, use a vacuum cleaner equipped with a HEPA filtration system. Vacuum the interior, including the sample drawer below (Figure F-4).
5) Break open the plates and vacuum the plates' interiors.
6) Use a wire brush to clean the plates and remove caked material.
7) Vacuum the entire equipment.
8) Use alcohol wipes to clean the entire equipment.
9) Using a feeler gauge, reset the plate distance for M435 pulverization (Figure F-5).
10) Change the hand gloves of the technician doing sample preparation.
11) Introduce the second purge of the grinder using two 1/4 liter scoops (about 1 cup per scoop) of quartz sand. The powder from the second purge should be discarded appropriately.
12) Re-clean the interior chamber with a new brush and slam the plate cover to loosen powdered debris.
13) Vacuum the entire equipment, especially inside the plate feeder.
14) Run the plate grinder and use pressured air to clean the plate grinder.
15) Vacuum the entire equipment.
16) Use alcohol wipes to clean the entire equipment. The cleaning procedure takes approximately 12-15 minutes, depending on how experienced the technician is in cleaning this equipment.
17) The plate grinder is now ready for the next sample.

*Purging materials must have been tested by polarized light microscopy and transmission electron microscopy and shown not to contain asbestos ("blank material"). Materials used for purging during the cleaning procedures should be discarded appropriately.

Figure F-1. Increase distance of plates.

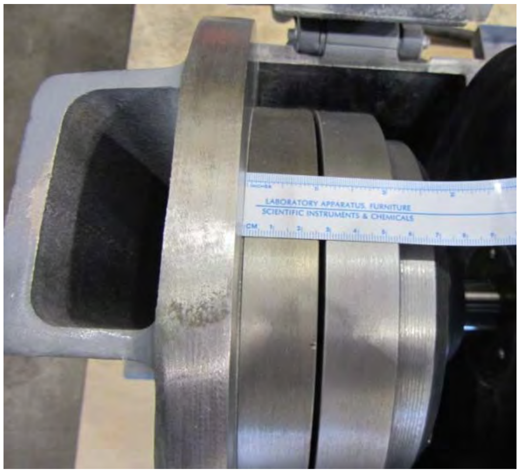


Figure F-2. Loosen the locking handle.

Figure F-3. First purge with limestone.

Figure F-4. Vacuum the sample drawer.

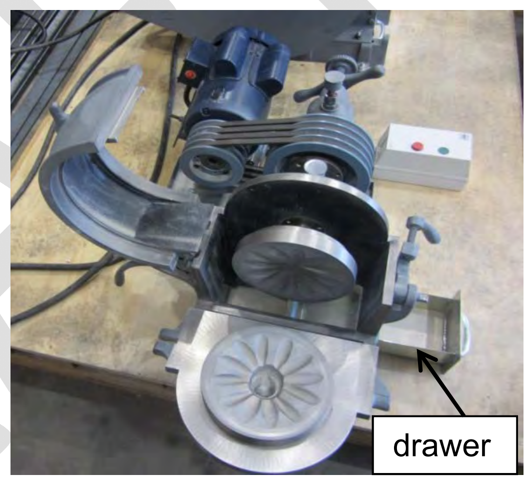
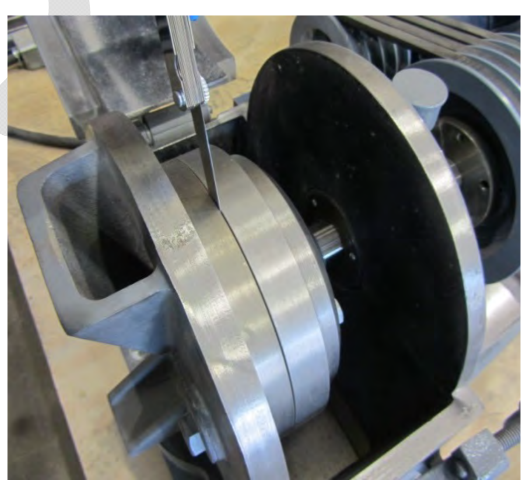


Figure F-5. Reset the plate distance.



Appendix G

Test Method 435 Sample Processing Procedures: The Addition of a Mixing Procedure and Its Effect on Sample Homogeneity

INTRODUCTION

Background

The California Air Resources Board's (ARB) Test Method 435 (M435) requires the following sample processing steps prior to analysis of possible naturally occurring asbestos containing samples by polarized light microscopy (PLM):

1. Drying of field sample.
2. Crushing to less than 3/8-inch (9 1/2-millimeter) diameter particles.
3. Riffle splitting to reduce the size of the original field sample (to one pint).
4. Pulverizing the one pint sample to a powder sample (less than 75-micrometer diameter particles).

An aliquot of the sample powder is then taken for PLM analysis. The amount of powdered sample actually viewed under the polarized light microscope for a M435 analysis is about 40 milligrams. Oftentimes, this is a sample size reduction of about a 10^{-5} (or approximately 1/100,000 of the original sample) when compared to the field sample received by the laboratory.[1] Therefore, it is important that steps be taken to ensure that this small subsample is representative of the bulk field sample submitted.

Although the pulverization procedure can mix the sample to a small degree (depending on the type of equipment used), this step is not specifically intended to homogenize a large sample. Therefore, ARB staff recommends the addition of a mixing step to increase the homogeneity of the M435 sample prior to taking the aliquot for PLM analysis. This additional step would improve the accuracy and precision of M435 analyses.

After preliminary investigations, ARB staff chose to use a 3-dimensional (3-D) mixer (88 Mixer System Schatz Model 4 (1A), Inversion Mixers, Ponaka AB, Canada) to assess the benefits of adding a mixing procedure to M435 processing. The motion of the 88 mixer is based on the Schatz inversion kinematic, which uses a combination of three types of motions: rotation, translation (reciprocation), and inversion. The alternating motion has a thickening and thinning effect on the sample being mixed. The resulting eddies produce a changing and predictable energy gradient that mixes the sample. The Schatz kinematic 3-D mixer was selected because it has been established as an effective mixer of solids such as drugs, ceramics, foodstuffs, and others.
A sample can be mixed in its own container as long as the container size is not larger

[1] Assuming 1-pint field sample, particle density of 2.65 grams/milliliter, and 30 percent porosity.

than the mixer's capacity. This helps avoid cross-contamination during sample preparation.

Purpose

The purpose of this study was to observe the effect of adding a mixing step on sample homogeneity and the resulting variation of analytical results for a target analyte.

Preliminary Study

ARB staff conducted a preliminary study on mixing by observing the effect of pulverization (using a plate grinder) on the distribution of red-colored tracer material.

Approximately 3,380.00 grams of oven-dried salt (sodium chloride) was spiked with 2.83 grams of dyed red chalk consisting of calcium carbonate (Figure G-1A). Both materials were combined and pulverized using a plate grinder. After pulverization, there was visible uneven distribution of reddish color (Figure G-1B) in the powdered sample.

Upon transfer of the powdered sample to a one-gallon (approximately 4-liter) glass jar, distinct layering in the pulverized sample was visible. Some layers had relatively higher concentrations of spiked, red-dyed material, while other layers had virtually no spike material and were generally white (Figure G-1C). However, after homogenization using the 3-D mixer at 40 revolutions per minute (rpm) for four minutes, the entire powdered sample appeared to be *pink* in color and homogeneous (Figure G-1D).

Verification of the salt sample's optical characteristics using PLM is shown in Figure G-2. The salt matrix before mixing appears to be mostly dark (isotropic) under crossed polar using PLM (Figure G-2A) with few impurities as indicated by the small number of bright particles. After mixing for four minutes, the homogenized powder is seen with the finely disseminated, highly birefringent, evenly-distributed chalk powder observed as bright particles against the dark salt matrix (Figure G-2B). Even at 100X magnification (mag), the chalk appears to be relatively homogeneous.

MATERIALS AND METHODS

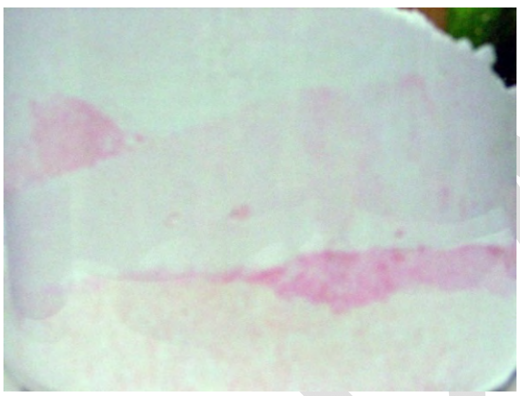
Study Design

Based on the results of the preliminary study, ARB staff conducted further tests using different matrix and spike materials. Marble was chosen as the matrix because it can be easily dissolved in hydrochloric acid (HCl). Non-asbestos crystalline actinolite was chosen as the spike because it is insoluble in HCl and its prismatic crystals resemble the shape of asbestos fibers, but without the toxicity. Acid-dissolution tests of the powdered marble were done to determine the mass of insoluble crystals (impurity) in a known mass of pulverized marble.

Figure G-1. Preliminary Mixing Test Using Salt and Red Chalk

A. Crushed salt and red chalk (spike) before pulverization using plate grinder.

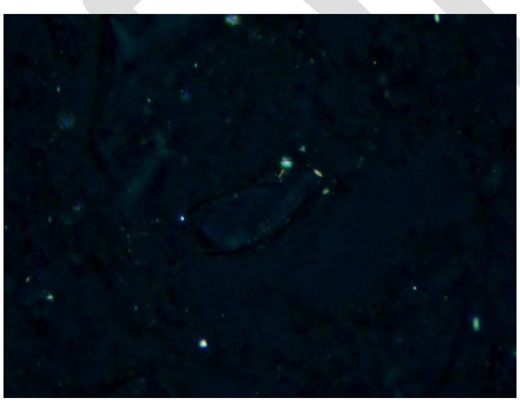
B. Salt and red chalk (spike) after pulverization.



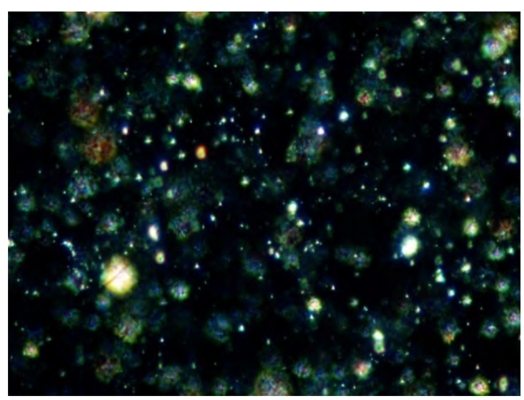
C. Stratified sample before mixing.

D. Homogenized sample after mixing.

Figure G-2. PLM Analysis of Preliminary Mixing Test



A. Salt matrix (isotropic) before mixing.
100X mag, PLM, crossed polars.



B. Pulverized salt matrix and chalk (bright particles) after mixing.
100X mag, PLM, crossed polars.

Two actinolite spike concentrations were chosen (0.25 percent and 0.10 percent by weight, wt%) for the study. Samples were homogenized using the 3-D mixer at 40 rpm. Mixing periods of 0, 3, 5, and 7 minutes were selected.

Three replicate experiments per mixing duration were performed. Three core subsamples were obtained from each replicate sample. Core subsamples were dissolved in HCl to determine the mass of actinolite in the subsample. The study sample collection design is shown in Table G-1.

Table G-1. Sample Collection Design

Mixing Time (min)	0.25 wt%			0.10 wt%			Grand Total Samples
	No. of Replicates	No. Core Samples Per Replicate	Total	No. of Replicates	No. Core Samples Per Replicate	Total	
0	3	3	9	3	3	9	**18**
3	3	3	9	3	3	9	**18**
5	3	3	9	3	3	9	**18**
7	3	3	9	3	3	9	**18**
Total			36			36	**72**

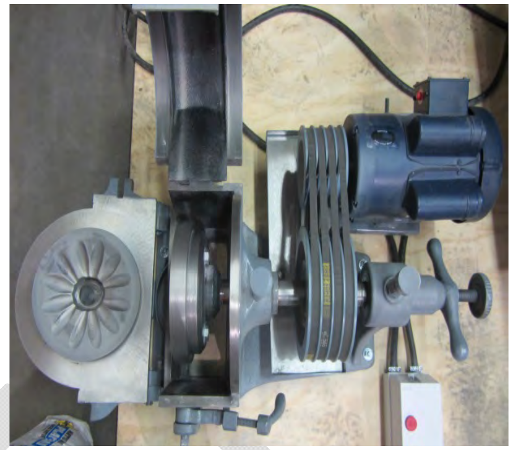
Sample Preparation

About 130 kilograms of natural marble and one kilogram of prismatic actinolite were separately dried in an oven at 105 degrees Celsius (ºC) for 24 hours. These materials were crushed to 3/8-inch (approximately 9 1/2-millimeter) diameter particles with a Chipmunk Jaw Crusher (Bico Braun International, Burbank, CA) (Figure G-3A). Subsequently, each material was pulverized with a plate grinder (UA Disc Pulverizer, Bico Braun International, Burbank, CA) (Figure G-3B and 3C). Both processes were performed in separate locations to avoid cross-contamination between the two materials.

The blank marble powder was dissolved with HCl to identify and quantify the natural impurities. The pulverized actinolite spike was analyzed by PLM (Figure G-3D) to verify the composition.

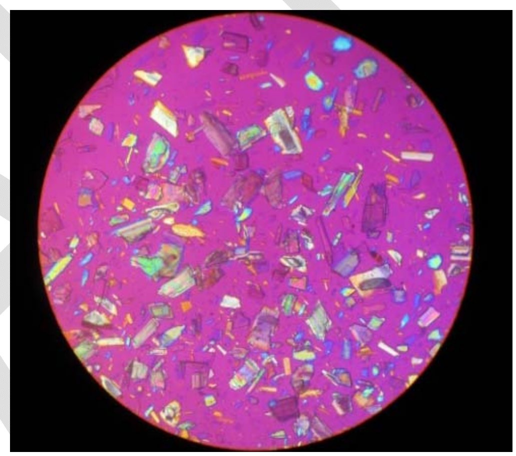
Figure G-3. Sample Preparation of Actinolite and Marble

A. Crushed sample.



B. Plate grinder for pulverization.

C. Pulverized marble.



D. Actinolite by PLM (100X mag, crossed polars, gypsum plate, field of view diameter = 2mm).

Determining the Impurity of the Pulverized Marble

Prior to mixing actinolite-marble mixture, the purity of the marble was checked. To do this, approximately 2,600 grams of pulverized marble was placed in each of pre-weighed 24 plastic containers. The plastic containers were shut and the lids were sealed with duct tape. Each sample was placed in the Schatz kinematic 3-D mixer, secured, and mixed at 40 rpm for seven minutes. At the end of each mixing, the samples were allowed to stand for five minutes for dust inside to settle. Subsequently, three core subsamples of the mixed powder were collected. Method for core subsample collection is provided below. The three core subsamples were mixed to provide one subsample for each container. The combined subsamples were analyzed for impurities (acid insoluble solid). Each of these marble in the 24 plastic containers was used for subsequent mixing tests of actinolite-marble mixture.

Preparation of Actinolite-Marble Samples

To prepare approximately a one-liter (L) actinolite-marble mixture sample with 0.25 weight percent actinolite spike, each of the approximately 2,600 grams of pulverized marble in 12 plastic containers was reduced to 2,463.83-grams in the pre-weighed, plastic container (Figure G-4A). The actinolite spike (6.175 grams) was weighed on a tared glassine paper using a microbalance with sensitivity of 10^{-4} grams, labeled, and stored for use during the experiment. Twelve samples spiked with 0.25 weight percent actinolite were prepared. The remaining 12 containers of approximately 2,600 grams of pulverized marble were used to prepare a set of 12 samples spiked with 0.10 weight percent actinolite. For this sample, 2.470 grams actinolite and 2,467.53 grams of pulverized marble was mixed for each sample container.

To have a uniform starting position of the actinolite spike in all of the marble sample replicates, an approximately a 2-centimeter wide by 2-centimeter deep well was made in the center of the upper surface of the marble powder. The actinolite powder was placed in the well (Figure G-4B) and covered with marble powder (Figure G-4C). The plastic container was shut and the lid was sealed with duct tape (Figure G-4D).

Procedure for Unmixed Samples (3-D Mixing Duration = 0 Minutes)

After spiking the sample, the sealed sample container was manually inverted upside down three times in a quick succession (Figure G-5A) to represent minimal mixing that would have occurred if the target analyte were pulverized concurrently with the matrix material.[2] The sample container was placed on a flat surface for five minutes to allow inside dust to settle. Subsequently, three core subsamples of the powder were collected. Three replicate samples of “zero minute” mixing were prepared for each spike concentration resulting in nine core subsamples collected for the 0.25 weight percent actinolite spike samples and another nine core subsamples for 0.10 weight percent actinolite spike samples.

[2] Spikes were not introduced before crushing or pulverization because a small amount of material is always “lost” in these processing procedures (e.g. in equipment, through fume hood, etc.); therefore, the target concentration after processing could be slightly different.

Figure G-4. Preparation of Actinolite-Marble Sample Mixture

A. Weighing the marble matrix.

B. Adding the pre-weighed actinolite.

C. Covering actinolite with marble.

D. Container was sealed.

<u>Procedure for Mixed Samples (3-D Mixing Duration = 3, 5, and 7 Minutes)</u>

After inverting the sealed sample container three times, as described above, each container was placed in the Schatz kinematic 3-D mixer, secured, and mixed at 40 rpm for the appropriate experimental duration (3, 5, or 7 minutes) (Figure G-5B). The mixed sample was gently placed on a flat surface for five minutes to allow inside dust to settle. Subsequently, three core subsamples of the mixed powder were collected. Each sample is replicated three times. A total of nine samples were mixed for samples spiked at 0.25 weight percent actinolite and another nine samples mixed for samples spiked at 0.10 weight percent actinolite. Three core subsamples were collected from each replicate sample (Table G-1).

Figure G-5. Mixing Samples Using Hand and 3-D Mixer

A. Hand mixing the sample.

B. Sample was secured in 3-D mixer.

Collection of Core Subsamples

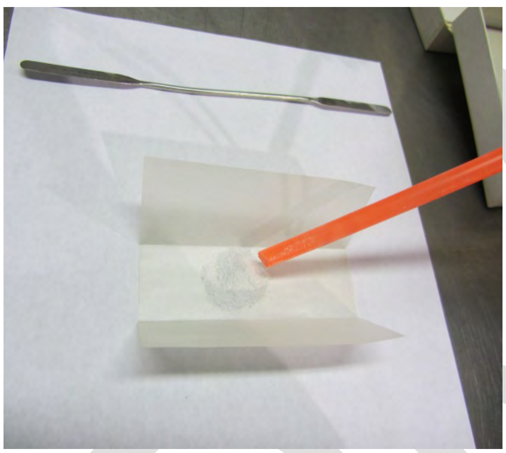
Three core subsamples were taken from each sample using a “sample thief” (Figure G-6A). The sample thief consisted of a large plastic straw with a diameter of approximately 8 millimeters (approximately 5/16 inch) and a length of 20 centimeters with one end diagonally cut. Three sample thieves were inserted vertically in three locations at random on the sample surface (Figure G-6B) down to the bottom of the sample container.

Each core subsample was placed on a tared glassine paper (Figure G-6C), weighed, and stored in the folded glassine paper (Figure G-6D) until the next step (dissolution). A total of 72 core subsamples were collected for this study (Table G-1).

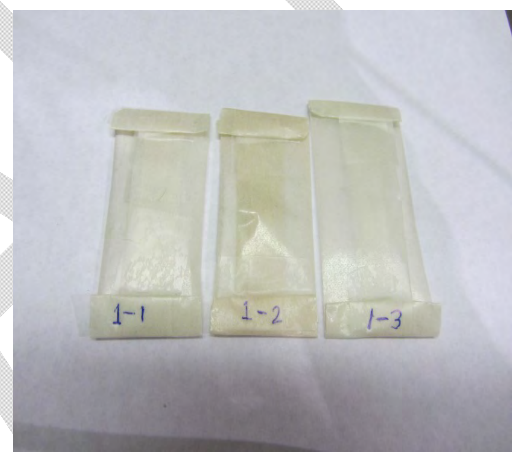
Figure G-6. Obtaining Core Subsamples

A. Sample thief.

B. Taking three core subsamples.



C. Core subsample collected.



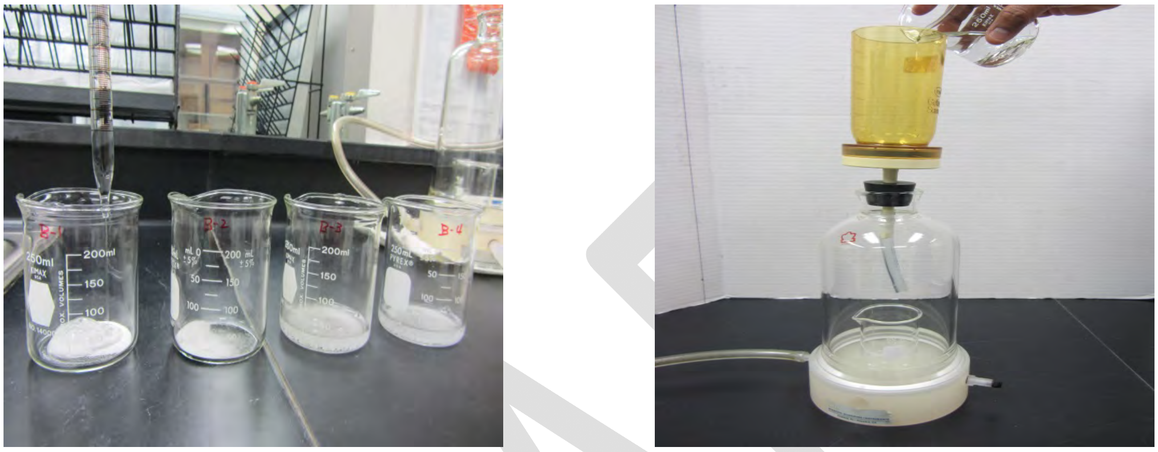
D. Core subsamples labeled and stored.

<u>Sample Dissolution</u>

The objective was to determine the mass of the actinolite spike in each of the marble-actinolite core subsamples by dissolving the calcium carbonate in the marble-actinolite mixture and quantifying the acid-insoluble actinolite. The purity of the marble was determined by dissolving a known mass of pulverized marble with HCl to determine the percentage of acid-insoluble solids (impurity) in the untreated marble. Each sample container had a blank reading for initial impurity content.

Each core subsample was placed in a 250-milliliter beaker and 30 milliliters of 10 percent HCl was added to dissolve the marble (Figure G-7A). After the reaction was completed, the digest was filtered through a pre-weighed, 47-milliliter Teflon filter with 0.45-micrometer openings using a filter-suction system (Figure G-7B). The residue was rinsed with distilled deionized water. The Teflon filter with residue was placed on a clean tray and air-dried for 24 hours. It was post-weighed to determine the mass of the remaining residue from each core subsample. The difference between the mass of the dried filter with residue and the empty Teflon filter is the mass of the spike. The mass of acid-insoluble impurities from an equivalent mass of marble matrix was also deducted from the total mass of the collected residue. The same procedure was used for all 72 subsamples.

Figure G-7. Dissolution of Marble-Actinolite Mixture and Filtration



A. Dissolution of core subsamples. B. Suction filtration of acid digest.

The post-dissolution concentration of actinolite in each core subsample was calculated in grams of actinolite per gram of marble. The average and standard deviation for each treatment (subsamples with the same duration of mixing) were also calculated for each concentration of actinolite (0.25 weight percent and 0.10 weight percent spike).

RESULTS AND DISCUSSION

The results for samples spiked with 0.25 weight percent actinolite are shown in Figures G-8 and G-9. At zero minute mixing (sample container was manually turned upside down three times, no use of 3-D mixer), there was great variability in actinolite concentrations measured, ranging from 0.0012 to 0.0398 g actinolite/g marble. As the mixing duration increased, the range of actinolite concentrations became narrower with a sharp decrease in the standard deviations (Figure G-9).

These results indicate that unmixed samples have much higher variability of actinolite concentrations when compared to samples that were homogenized using the 3-D mixer. When compared to the unmixed samples, the mixed samples (3, 5, and 7 minutes) consistently showed lower (and closer to the spiked concentration) average concentrations of actinolite. The standard deviations of the nine replicates of mixed samples decreased significantly indicating that the actinolite is more evenly distributed within the marble matrix. Therefore, the mixed samples resulted in more accurate and precise measurements of actinolite.

Figure G-8. Actinolite-Spiked Samples (0.25 Wt Percent) and Mixing Duration

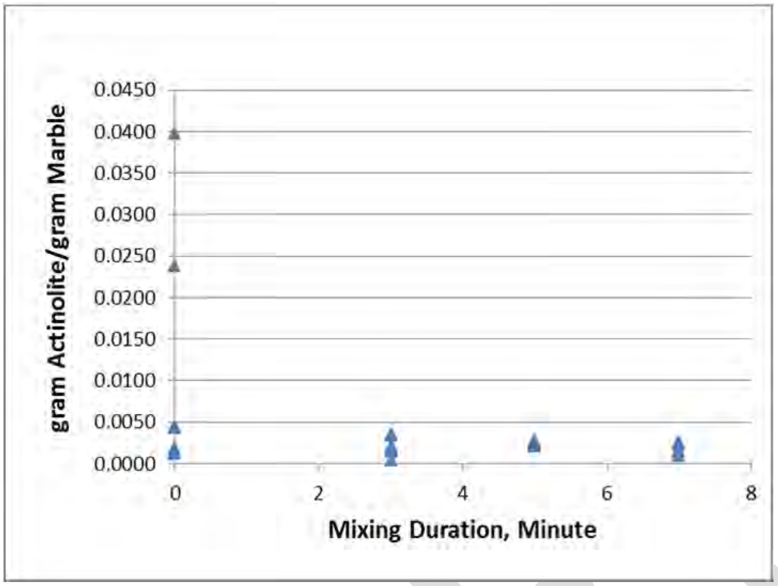
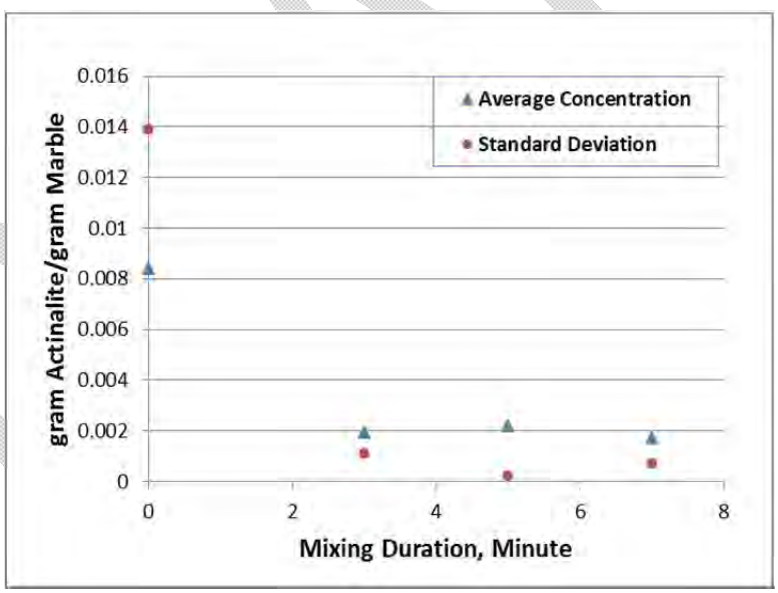
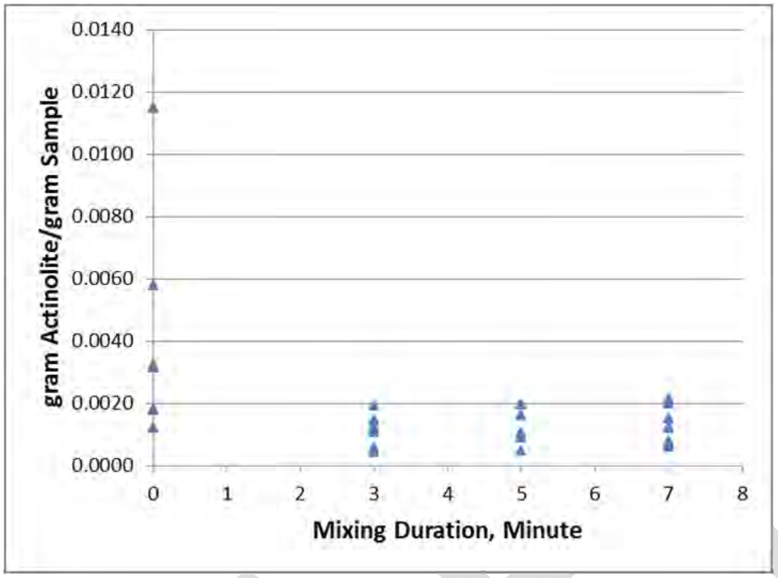


Figure G-9. Average and Standard Deviation of Actinolite-Spiked Samples (0.25 Wt Percent) and Mixing Duration



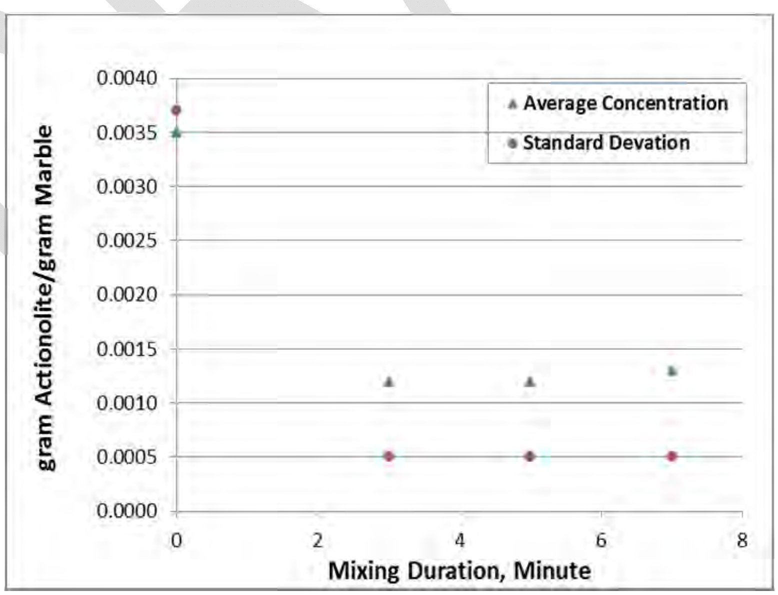
The data from the 0.10 weight percent actinolite-marble samples follow the same trends observed in the 0.25 weight percent actinolite-marble samples (Figures G-10 and G-11). The actinolite concentrations measured from unmixed samples are significantly higher and more variable than the actinolite concentrations from the mixed samples. These samples were spiked with 0.10 weight percent actinolite but the actinolite concentrations measured from unmixed samples were approximately three times higher than 0.10 weight percent, indicating that the core subsamples from unmixed samples included pockets of unmixed actinolite.

Figure G-10. Actinolite-Spiked Samples (0.10 Wt Percent) and Mixing Duration



In contrast, the mixed samples did not show this large variability. As shown in Figure G-11, the standard deviations of mixed samples were about 13 percent of that for the unmixed samples indicating that, in the mixed samples, the actinolite is more evenly distributed within the marble matrix.

Figure G-11. Average and Standard Deviations of Actinolite-Spiked Samples (0.10 Wt Percent) and Mixing Duration



The average actinolite concentrations reported in the mixed samples are about the same as the initial spike concentrations of 0.10 weight-percent or 0.25 weight-percent.

The optimal mixing duration represents the minimum amount of time needed to homogenize the unmixed sample so that accurate and repeatable results can be obtained from taking the subsamples. For both concentrations, three minute mixing was sufficient to provide optimal concentrations. As shown in all four figures, there is no significant difference in mixing after three minutes, all with the lowest standard deviations. This may suggest that mixing of about a liter of powdered actinolite-marble mixture for three minutes is sufficient to get the optimal mixing.

CONCLUSIONS

In summary, the concentrations of actinolite in unmixed samples were highly variable (higher standard deviation) accompanied with a higher average. In contrast, samples that were homogenized with the 3-D mixer had much less variability (lower standard deviation) with a lower (and more accurate) mean actinolite concentration.

Both the preliminary chalk-salt mixing study and this actinolite-marble study suggest that homogenization of powdered mineral samples before analysis for asbestos content is beneficial. The results clearly show that the addition of a mixing step into M435 processing procedures can greatly improve the accuracy and precision of the analytical results.

Appendix H

Asbestos Quantification by Point-Counting: Statistical Decision-Making Errors

California Air Resources Board Test Method 435 Point-Counting Procedure

Asbestos quantification per California Air Resources Board (ARB) Test Method 435 (M435) is performed by a point-counting procedure. Point-counting is a well-established, standard technique in petrography for determining the relative areas occupied by separate minerals in thin sections of rock. An ocular reticle (point array) or crosshair reticle is used to visually superimpose points on the microscope field of view. A total of 400 points superimposed on either asbestos fibers or non-asbestos matrix material must be counted over at least eight different preparations of representative subsamples. Eight forceps samples are taken and mounted each separately on different slides with the appropriate refractive index liquid.

The percent (%) asbestos is calculated as follows:

% asbestos = (a/n) 100%

a = number of asbestos counts
n = number of nonempty points counted (400)

ARB staff has observed that some laboratories offer more “sensitive” M435 analyses that include counting more than 400 points. ARB staff supports counting more than 400 points but recommends that it be done in multiples of 400 (i.e., 800, 1,200, etc.). If counts greater than 400 are performed, but not in multiples of 400, the chances of reporting a sample to be less than 0.25 percent may increase, when, in fact, it is greater than 0.25 percent.

Introduction to Decision-Making Errors – False Positives and False Negatives

An analyst often makes conclusions about a population based on a subset of data that is available. In such instances, there is always a chance that the analyst may report a wrong conclusion when the truth is unknown. For example, in the point-count method, if the true proportion of asbestos is less than 0.25 percent, but the analyst finds a greater percentage of asbestos in a subset of data and subsequently declares the larger, original field sample to be greater than 0.25 percent, then the reported result is said to be a “false positive” (“false” indicates a wrong conclusion is being made, and “positive” indicates that the reported asbestos content is present above a certain threshold, e.g., 0.25 percent).

On the other hand, if the true proportion is greater than or equal to 0.25 percent, but the analyst finds less than 0.25 percent in the subset of data, then the reported result is said to be a “false negative” (“false” indicates a wrong conclusion is being made, and “negative” indicates that the reported amount of asbestos identified is below the threshold).

Declaring a sample to have asbestos either above (or below) a certain threshold is a "true or false" process. In statistics, this is modeled as a binomial process.[1] The following figures and discussion take into account only the statistical probability associated with the binomial process and do not take into account the other sources of variability associated with M435.

False Positives/Negatives as a Function of Sample Concentration

Under the scenario of counting 400 points, if the true asbestos content is 0.75 percent by point count, the point-count method will correctly identify the sample as being greater than or equal to 0.25 percent 95 percent of the time (Figure 1). Therefore, due to chance, the point-counting under these conditions will provide false negatives five percent of the time (100 percent – 95 percent = 5 percent). That is, the "false negative" probability rate is five percent. See Figure 2.

As Figure 1 shows, if the true asbestos content is 0.05 percent by point count, the point-count method will *incorrectly* identify the sample as being greater than or equal to 0.25 percent 18 percent of the time (i.e., the false positive rate is 18 percent). Conversely, the point-count procedure will correctly identify this sample to be less than 0.25 percent 82 percent of the time (100 percent – 18 percent = 82 percent) as shown in Figure 2.

As can be seen from both figures, the probability of making a false positive or false negative declaration increases near the decision threshold (in this case, 0.25 percent) but decreases as the true asbestos percentage deviates from the threshold.

False Positives/Negatives as a Function of Number of Points Counted

The rate of correctly identifying an asbestos sample as above or below a certain threshold (e.g., 0.25 percent) also changes as the number of points counted changes; therefore, the rate of reporting false positives or false negatives will change as well. Figure 3 illustrates this phenomenon.

The sharp peaks in probabilities occurring at increments of 400 (points counted) are due to the rejection rule of 0.25 percent. When using this threshold and counting in multiples of 400 (i.e., 400, 800, 1,200, etc.), the number of fibers it takes to "tip" the threshold is in whole numbers (e.g., for 400 points, 0.25 percent is one fiber; for 800 points, 0.25 percent is two fibers, etc.). If an analyst were to count one additional point (i.e., 401), then 0.25 percent multiplied by 401 would be 1.0025 fibers. Since an analyst cannot detect and count partial asbestos fibers, the real-world threshold in a 401 point count is two fibers. Two fibers will remain as the threshold until the point count increases above 800 points.[2] The following discussion considers cases when additional points (800, 1,000, and 1,200) are counted.

[1] http://homepages.wmich.edu/~bwagner/StatReview/Binomial/binomial%20probabilities.htm
[2] The first sharp drop in probability in Figure 3 occurs at the 401 point count. A progressive increase in probabilities is observed as the point count increases from that point on until the next multiple of 400 is reached, that is, 800 points.

As indicated in Figure 3, when the true asbestos content is 0.35 percent, the point-count procedure will correctly identify the sample as being greater than or equal to 0.25 percent 75, 77, and 79 percent of the time when 400, 800, and 1,200 points are counted, respectively. However, when 1,000 points are counted, the procedure will only correctly identify the sample as being greater than or equal to 0.25 percent 68 percent of the time. Therefore, the false negative error rate is actually higher for the 1,000 point-count than the 400 and 800 point-count.

The above scenario does not apply to the false positive error rate. For instance, if the true asbestos content is 0.10 percent by point count, the point-count method will *incorrectly* identify the sample as being greater than or equal to 0.25 percent 33, 19, and 12 percent of the time when 400, 800, and 1,200 points are counted, respectively. This is the false positive error rate. When 1,000 points are counted, the false positive error rate is eight percent, which is lower than the rate associated with either the 400, 800, or 1,200 point count. (The point-count procedure will correctly identify this sample to be less than 0.25 percent 67, 81, and 88 percent of the time when 400, 800, and 1,200 points are counted, respectively.)

Figure 4 depicts yet another way of illustrating the false positive and false negative rates as a function of true asbestos content and the number of points counted. Some key points from the graph, and also shown in earlier charts, include:

1) False positive/negative error rates increase substantially near the decision threshold (e.g., 0.25 percent) but drop significantly as the true asbestos percentage deviates from the decision threshold.
2) Increasing the point-count in multiples of 400 reduces both the false positive and false negative error rate, but the statistical benefit is greater in limiting the false positive rate.
3) The 1,000 point-count procedure will lead to lower false positives than the 400 and 800 (and 1,200) point count procedures; however, the false negative error rate becomes substantially higher in comparison to the 400, 800, and 1,200 point-counts when the true asbestos percentage is above the decision threshold (i.e., 0.25 percent) and less than approximately 0.50 percent.

Although increasing the number of points counted beyond 400 does increase the sensitivity of the quantitation of the asbestos content, doing so does have an effect on the false positive and false negative error rate. The false positive error rate will drop considerably for any point count above 400. On the other hand, the false negative rate could increase substantially if not done in multiples of 400. Therefore, to maximize the benefit of any increase in the number of points counted, ARB staff recommends that such an increase be done in multiples of 400.

**Figure 1. Probability of Declaring Sample ≥ 0.25 Percent
400 Point Count**

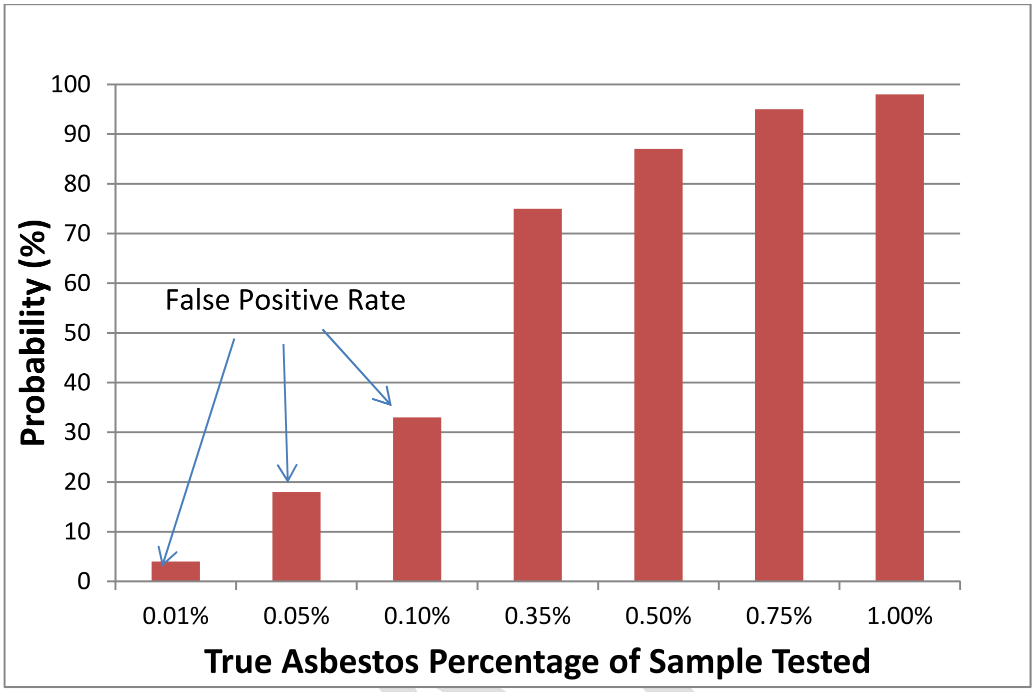


**Figure 2. Probability of Declaring Sample < 0.25 Percent
400 Point Count**

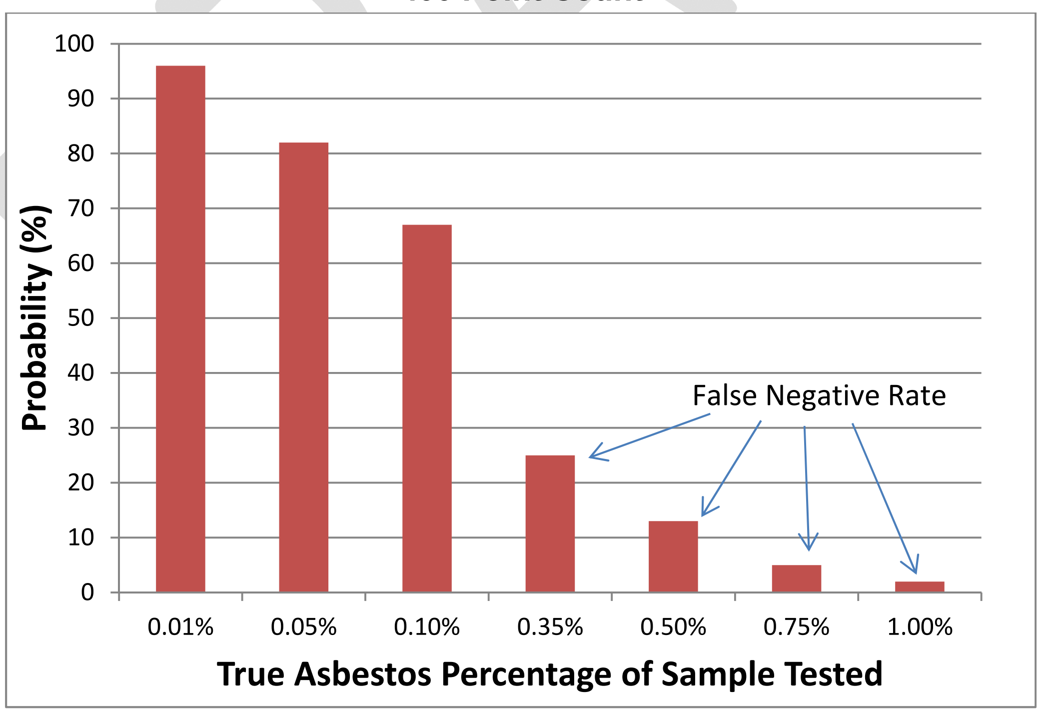


Figure 3. Probability of Declaring Sample ≥ 0.25 Percent

100-2000 Point Count

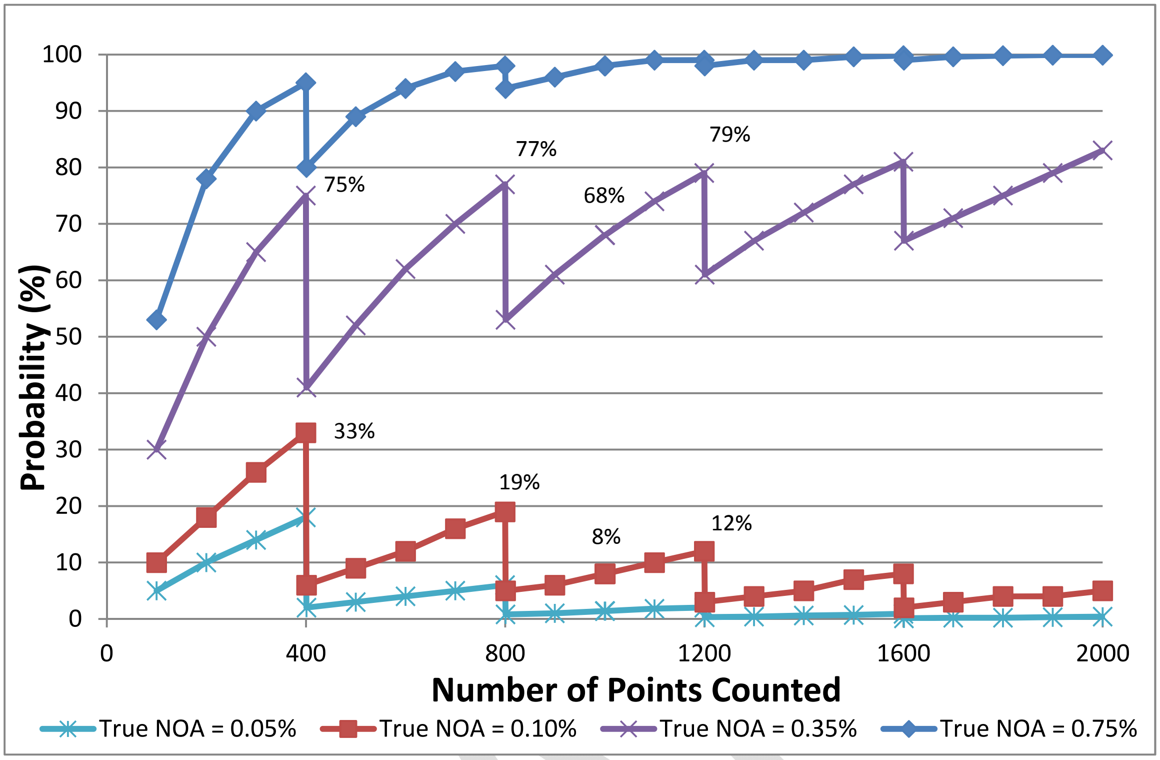
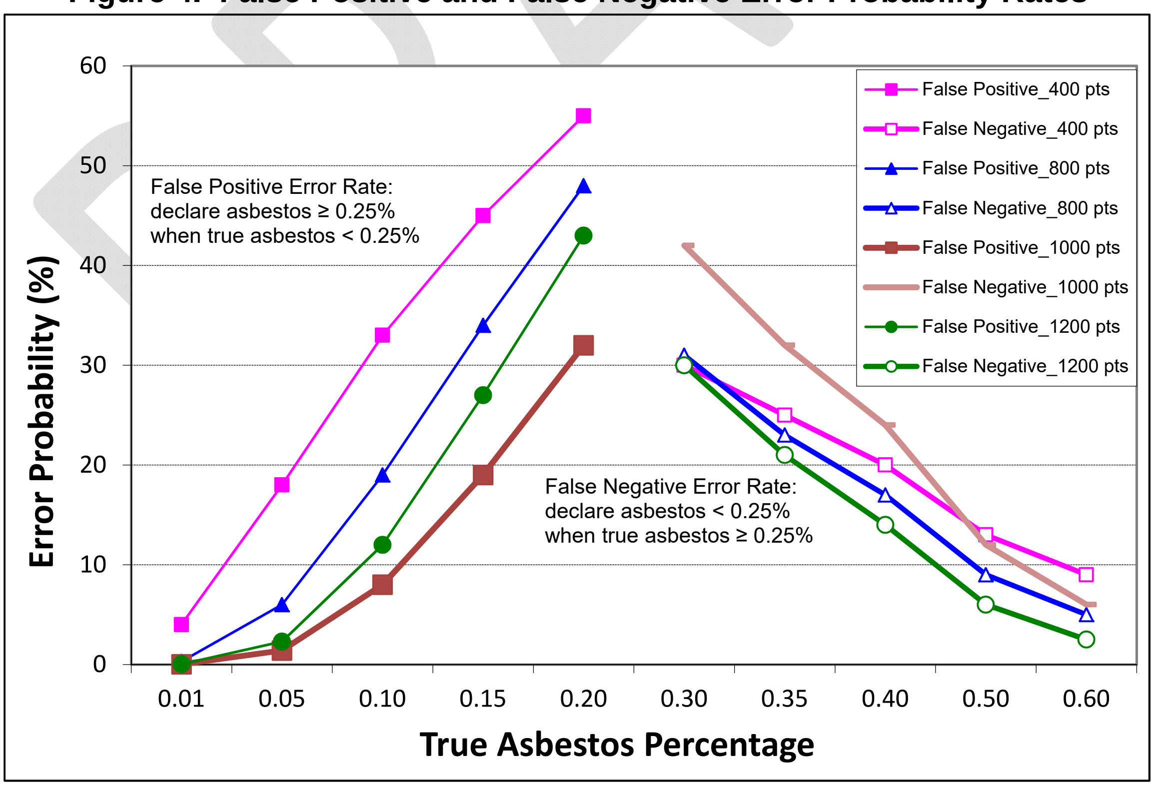


Figure 4. False Positive and False Negative Error Probability Rates



Appendix I
Example of Method 435 Sample Chain of Custody

Submitted by Client		Print Name:		Date:	
		Signature:		Time Submitted:	
Client Company:				Tel. No.	
Address:				Email:	
Job Site:					
Received by Laboratory		Print Name:		Date:	
		Signature:		Time Received:	
Sample No.	Sample Name	Analyst Initials	Sample Type and Volume (e.g., rocks, soil, aggregate, other)	Features for Targeted Analysis? (Y=Yes N=No)	Other Tests in Addition to M435
PLM Analysts		1. Print Name:		Other Tests Done by	Print Name:
		Signature:			
		2. Print Name:			Signature:
		Signature:			
Additional Information:					
Returned by Laboratory		Print Name:		Date:	
		Signature:		Time Returned:	
Received by Client		Print Name:		Date:	
		Signature:		Time Received:	

Appendix J

Recommended Training and Experience for M435 Asbestos PLM Analysts

The identification of naturally occurring asbestos (NOA) in rocks and soils depends on the training and experience of the microscopists with polarized light microscopy (PLM).

All laboratory personnel who participate in the preparation and analysis of rock and soil samples using Test Method 435 (M435) should be familiar with their laboratory's safety practices for handling samples that may contain asbestos. These safety practices should be included in the laboratory's approved standard operating procedures (SOP) that are specific for this method.

A. Recommended Training

PLM analysts should have successfully completed a course in optical mineralogy. Other helpful courses would include mineralogy and petrography, or equivalent. These courses should be taken at a college, university, or accredited learning institution for continuing education and training. Formal training or courses specifically on the identification of asbestos using PLM are highly recommended.

The following are recommended training subjects and practical experiences for microscopists who analyze rocks and soils for asbestos content using PLM, as described in M435. These training subjects should give the analyst a thorough understanding of how light is observed through a polarized light microscope and how these observations relate to the crystal structure and mineral characteristics. Furthermore, an understanding of the occurrences, mineral associations, and alteration of asbestos will prepare the analyst for the recognition and identification of asbestos in weathered rock or soil samples.

A1. Theories of light, its properties, and refraction.

A2. Optics and the petrographic microscope: assembly, illumination, mechanical and optical alignment, calibration, and routine maintenance. Sample preparation techniques for PLM and considerations.

A3. Plane polarized light in minerals: polarization, birefringence, optical indicatrix, Michel-Levy interference colors, and extinction characteristics.

A4. Mineral crystal systems and optical crystallography: descriptions of mineral morphology and optical characteristics; principles and use of compensators.

A5. Systematic identification of asbestos minerals using PLM oil immersion technique: morphological properties and optical characteristics of asbestos minerals; M435 Table 3.

A6. Identification of asbestos using dispersion staining techniques (i.e., M435 Table 4).

A7. Asbestos occurrences, alterations, and mineral associations.

A8. Common asbestos interference minerals (look-alikes) and how to differentiate them from asbestos.

B. Recommended Experience

B1. Formal course, at least in optical mineralogy for asbestos, as described above. Other helpful courses would include mineralogy and petrography.

B2. Familiarization with naturally-occurring asbestos at different stages of mineral alteration in rocks and soils.

B3. Comparison of asbestos and their non-asbestiform, equivalent minerals of similar composition.

B4. At least a two-month, full-time practical training on asbestos identification in rock and soil samples under a supervising microscopist at a laboratory accredited by the National Voluntary Laboratory Accreditation (NVLAP), Environmental Laboratory Accreditation Program (ELAP), or equivalent.

A PLM analyst should demonstrate the ability to identify asbestos, according to asbestos characteristics described in M435 Table 3 and Table 4, and also differentiate asbestos from interference minerals that may be mistaken for asbestos. Part of the practical training should include the successful analysis of performance evaluation samples for asbestos and non-asbestos interference minerals. Following the training and experiences set forth in Sections A and B above, a supervising microscopist should oversee the analysis of laboratory samples by a newly-trained analyst for at least one week or until the supervisor is satisfied that he/she concurs with the analyses done by the new asbestos microscopist.

EUROFINS CEI LABS, INC
STANDARD OPERATIONS AND PROCEDURES:
Method 400: Bulk Analysis by PLM

"Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy"

Eurofins CEI Labs, Inc.
Method Number: PLM BULK SOP 400
Last Revision: February 10, 2021
Revision: February 1, 2022

1.0 Scope and Application

1.1 Bulk sample analysis by polarized light microscopy follows guidelines set forth in *40 CFR, Chapter 1 (7-1-87 Edition), Part 763, subpart F, Appendix A, pages 293-299*. Where applicable, procedures from *EPA/600/R-93/116 Method for the Determination of asbestos in Bulk Building Materials,* have been incorporated. No alternative methods shall be used without the approval of the Laboratory Director.

2.0 References

2.1 Primary sources for this method are 40 CFR, *Part 763, subpart F, Appendix A, pages 293-299,* along with *EPA 600/M4-82-020 Interim Method for the Determination of Asbestos in Bulk Insulation Samples*, and procedures from *EPA/600/R-93/116 Method for the Determination of asbestos in Bulk Building Materials*. The method is intended to comply with *the NIST Handbook, 150-3, Bulk Asbestos Specific Operations* Manual.

2.2 Other Laboratory Reference Materials:

2.2.1 40 CFR Part 763, Vol. 52, No. 210 *Asbestos Containing Materials in Schools; Final Rule and Notice*.

2.2.2 *Optical Mineralogy - Theory and Techniques. Volume 1*. 1987. Ernest G. Ehlers.

2.2.3 *Manual of Mineralogy*. 21st Edition. 1993 Cornelis Klein, Cornelius S. Hurlbut. After J.D. Dana

2.2.4 *Asbestos in Buildings - Bulk Sample Analysis*. 1990. The Environmental Institute.

2.2.5 EPA/600/R-93/116 July 1993. *Method for the Determination of Asbestos in Bulk Building Materials* R.L. Perkins and B.W. Harvey.

2.2.6 NIST Reference Manuals/Books 150 (rev. 2006-03-08) & 150-3, 150-13 and corresponding checklists.

2.2.7 NIST Technical Note 1297 (1994 ed.) *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*

3.0 Summary of Method

3.1 Trained analysts receive samples through the laboratory's procurement procedures.

3.2 Using a variety of techniques, and an examination of the material using a magnifying stereoscope, the analyst pulverizes, combusts, melts, or dissolves the sample to make a slide preparation.

3.3 After a slide preparation is prepared using solvent, refractive index oil, and/or dilute HCl, the analyst observes the preparation under the polarized light microscope.

3.4 The analyst determines, based on those optical properties obtained with a polarized light microscope, whether asbestos is present in the tested material, and at what percentage is present by a calibrated visual estimate.

3.5 Quantifying the percent asbestos in a sample by point count may occur at the customer's request.

3.6 Results for each sample are submitted to the customer in the form of a test report.

4.0 Sample Collection/Procurement

4.1 ECEI Labs does not collect samples from the field. ECEI receives samples from its customers requesting asbestos analysis by Polarized Light Microscopy.

4.2 Samples received by the laboratory from its customers are sampled out of the laboratory's control, and analysis is performed only on samples submitted under the conditions the samples are received.

5.0 Sample Log-In and Distribution

5.1 Samples are received and logged for proper test type according to The ECEI QA Manual Section 7.4 "Process Requirements: Handling of Test Items". Samples are received daily via courier, US Mail, or hand delivery. The items are opened in a negative air flow HEPA filtered acrylic hood, and prepared for login and distribution.

5.2 Procedures Specific Login and Distribution of Bulk Asbestos Samples:

5.2.1 Samples received in each sample lot are assigned a unique laboratory identification code and placed in a re-sealable plastic bag.

5.2.2 Information on each sample lot is to be recorded in the Bulk Asbestos Log Book kept available in the laboratory, on the chain of custody, and on the sample bag itself. This information will include the following:

5.2.2.1 Customer's name

5.2.2.2 Date of sample receipt,

5.2.2.3 Assigned project code

5.2.2.4 Total number of samples

5.2.2.5 Assigned laboratory identification numbers

5.2.2.6 The initials of the person making the above entries in the sample log book for each sample lot.

5.2.3 Criteria for sample rejection: In cases where incoming samples are rejected, clients are to be promptly notified. Reasons for rejection will be explained to the client and the client will be asked to resubmit the sample(s). Criteria for sample rejection are listed below:

5.2.3.1 Improperly packaged samples will not be accepted for analysis.

5.2.3.2 Sample containers that do not contain enough bulk material for accurate analysis should not be accepted.

5.2.3.3 Samples that are not properly identified with unique field identification numbers may not be accepted.

5.2.3.4 Samples that do not have the proper paperwork attached may not be accepted.

5.2.4 After samples are logged-in, they are to be taken to the sample distribution room and placed in the bins according to labeled due dates. They are now ready to be analyzed

5.2.5 The Laboratory Manager / Quality Manager selects samples on a daily basis from the sample distribution room by TAT for each analyst to analyze and places the samples in a polyethylene bin labeled with the analyst’s initials. The Manager will select less than the maximum capacity for each analyst on most occasions

5.2.6 When the analyst completes his/her analyses on each work order, the samples are selected for Quality Control Analyses.

5.2.7 Quality Control Selection and Distribution

5.2.7.1 Prior to the submission of any customer report, the original analyst takes their samples to QA/QC selector who selects a minimum of 10% of samples to be reanalyzed as QC samples.

5.2.7.2 The original analyst delivers the selected samples to their assigned QC analysts for duplication and may keep up to one third for replication.

5.2.7.3 QC analysts are assigned by room each day by quality control staff to every analyst.

5.2.7.4 In the event that assigned QC analysts are not present or available to read QC samples, the original analyst should take samples to the room assigned to their QC room.

5.2.7.5 In the event that an analyst has no QC analysts available (e.g. on weekends) then the analyst is responsible for having their QC samples analyzed as soon as the next analyst arrives.

5.2.7.6 In the event that no QC analyst is available and a report must be released to the customer before another QC analyst arrives, all QA/QC samples may be read as replicates.

5.2.8 Once Quality Control is complete, and any non-conforming work is resolved via corrective action, the analyst may return the QC samples to their original project and place the samples in their assigned 30+ gallon bin for disposal in accordance with Federal, State, and Local Regulations.

6.0 Facilities, Equipment, and Materials

6.1 PLM samples are analyzed at Eurofins CEI, Inc. (ECEI). ECEI occupies suites at 730 SE Maynard Road, Cary, NC 27511. The PLM department contains over 2000 sq. feet of tiled workspace devoted to PLM analysis.

6.2 An Equipment Manual is maintained by ECEI for the PLM department. The manual describes major pieces of equipment and maintenance procedures and records as required by Section 6.4 of the ECEI Quality Assurance Manual.

6.2.1 ECEI has a number of workstations for its PLM analysts. Each workstation is equipped with the following items:

6.2.1.1 An Olympus BHS (BH-2), Olympus BHSP (BH-2) Olympus BHT (BH-2), Nikon Optiphot 2, Meiji ML6120 or Leika DM EP polarized light microscope with 10x occulars w/ crosshair reticule, ≥530 nm wavelength retardation plate, bertrand lens, 10x, 20x, 10x dispersion staining, and 40x objectives, rotating stage, internal or external light source, and substage condenser equipped with achromat;

6.2.1.2 Magnifying dissecting stereoscope (10x up to 75x) with external light source;

62.1.3 HEPA filtered negative air flow hood capable of pulling an average air velocity of 75 ft/ minute,

6.2.1.4 A counter-top hot plate capable of reaching at temperature of 100°C;

6.2.1.5 Cleaning supplies and low lint paper tissue.

6.2.1.6 Refractive Index Oils, HD1.550 series E, 1.680 series B, HD1.605 series E, HD1.640 series E;

6.2.1.7 NaCl, Reagent Grade;

6.2.1.8 Mortar and Pestle;

6.2.1.9 #4 Scalpel Blade Handles with #20 Scalpel Blades.

6.2.1.10 Jeweler's forceps, 2 pair;

6.2.1.11 Spatula;

6.2.1.12 25mm x 75mm plain glass slides;

6.2.1.13 22mm x 22mm 1.5 thickness cover glass;

6.2.1.14 Pencil eraser or custom "squash" tool;

6.2.1.15 Dilute (10%) HCl solution;

6.2.1.16 Mortar and Pestle

6.2.1.17 Permanent Mount of Anthophyllite from NIST SRM 1867 in HD1.605 R.I. melt-mount material

6.2.2 ECEI has 8 separate PLM laboratory rooms containing 1-4 workstations each. Each laboratory room is equipped with the following items.

6.2.2.1 Laboratory thermometers (either liquid immersion or sensor type)

6.2.2.2 Microscope Lens Cleaner

6.2.3 ECEI labs also maintains the following for use by all laboratory employees as needed:

6.2.3.1 (2 sets) Refractive Index Oils, Maximum increments of 0.005 (or less) from 1.490-1.570 and 1.590-1.72

6.2.3.2 Optical Glass Standards. Cargille M-7 Reference set.

6.2.3.3 NIST Standard Reference Materials. (SRM 1866 Bulk Asbestos – Common & SRM 1867 Bulk Asbestos – Uncommon)

6.2.3.5 Chalkley or Cross-Hair Point Count Reticule

6.2.3.6 Powder-free latex examination gloves (multiple sizes)

6.2.3.7 Lab Coat (various sizes)

6.2.4 The following equipment is used when samples are submitted for gravimetric reduction:

6.2.4.1 Negative Air Flow Hood – capable of pulling an air velocity of 75ft/ min.

6.2.4.2 Muffle Furnace – calibrated to 480° Celsius

6.2.4.3 30 ml Ceramic / Porcelain Crucibles

6.2.4.4 Forceps

6.2.4.5 No. 4 scalpel blade handle with a No. 20 scalpel blade.

6.2.4.6 10% HCl solution.

6.2.4.7 6-Cup filtration manifold.

6.2.4.8 Filtration Apparatus (250 ml glass funnel with filtration base) and clips.

6.2.4.8 47mm, 0.45 ɰm pore size, Polycarbonate Filters

6.2.4.9 Distilled / Filtered Water

6.2.4.10 47mm plastic self-locking disposable petri plates capable of withstanding a 70° Celsius temperature.

6.2.4.11 Drying Oven

6.2.4.12 Fume Hood for Venting Muffle Furnace Exhaust

6.2.4.13 High Volume Pump

6.2.4.14 Ultrasonic Cleaner

7.0 Personnel and Training Requirements

7.1 Analysts typically are required to have a B.S. degree in the life or physical sciences and one year of laboratory experience. However, it is also recognized that accurate analysis of bulk asbestos requires attention to detail, common sense, diligent work practices, teamwork, and ethical conduct.

7.2 Exceptional applicants without a college degree, but with appropriate laboratory experience, may be considered for hire. Training schedules vary with the level of skill of each "New" Analyst; however, basic steps for in-house training are as follows:

7.2.1 "New" Analysts read the SOP/Quality Management System manual and become familiar with basic terminology and methodology. New employees are encouraged to ask questions as they are encountered.

7.2.2 "New" Analysts complete in-house instruction as specified in Appendix III: “In-house Training Program for Analysis of PLM Bulk Samples”, conducted by a qualified trainer. Classroom training follows a McCrone Institute format, with special emphasis placed on the identification of asbestos in bulk materials.

7.2.3 "New" Analysts are then partnered with experienced Analysts who assist them in analyzing multiple teaching modules, each a tutorial on different classes of bulk building materials. Results of the "New" Analyst are compared with established laboratory values. Discrepancies and outliers are discussed with the "New" Analyst.

7.2.4 Throughout the training modules, analysts are given series of quizzes and tests, the parameters of which must be attained by the “New” Analyst in order to proceed to the next module. Modules are organized as follows:

7.2.4.1 Practice Modules: Library of samples focusing on a particular category of bulk building materials with results provided to the “New” Analysts at the time of analysis.

7.2.4.2 Quizzes: Unknown sample set containing 15 samples of materials discussed in the accompanying practice module only. Analysts are graded on accurately detecting the presence or absence of asbestos and identifying the correct asbestos type when present. Following analysis, the mentoring Senior Analyst should discuss any discrepancies or outliers and aid “New” Analyst in obtaining the correct result on reanalysis. “New” Analysts are considered ready to continue to the next module once at least 90% of samples are reported correctly. “New” Analysts reporting less than 90% accuracy must reanalyze the quiz samples or practice module samples at their mentor’s discretion.

7.2.4.3 Tests: Unknown sample set containing 20 samples of materials discussed in any previous modules with emphasis on the most recent 2-3 modules. Analysts are graded on accurately detecting the presence or absence of asbestos and identifying the correct asbestos type when present and providing an asbestos percentage that is within an appropriate range for the sample material. Following analysis, the mentoring Senior Analyst should discuss any discrepancies or outliers and aid “New” Analyst in obtaining the correct result on reanalysis. “New” Analysts are considered ready to continue to the next module once at least 90% of samples are reported correctly. “New” Analysts reporting less than 90% accuracy must reanalyze the test samples, previous quiz samples or any previous practice module samples at their mentor’s discretion.

7.2.4.4 Final Exam: Unknown sample set containing 45 samples of materials discussed all previous modules. Analysts are graded on accurately detecting the presence or absence of asbestos, identifying the correct asbestos type when present, providing an asbestos percentage that is within an appropriate range for the sample material and correctly identifying any major non-asbestos components. Following analysis, the mentoring Senior Analyst should discuss any discrepancies or outliers and aid “New” Analyst in obtaining the correct result on reanalysis. Phase II is considered complete once the “New” Analysts reports at least 90% of samples correctly. “New” Analysts reporting less than 90% accuracy must reanalyze the final exam samples, previous test samples, previous quiz samples or any previous practice module samples at their mentor’s discretion.

7.3 After completion of the training modules, the "New" Analyst is then permitted to analyze samples previously completed by approved ECEI analysts. The “new” analyst receives 2 - 4 sample batches to get used to following customer instructions, and analyzing according to the ECEI PLM SOP.

7.3.1 Based on the Quality Manager's evaluation of the "New" Analyst's overall competency, the Analyst may be allowed to begin independent analysis on a commercial basis. Experienced Analysts start by re-analyzing 100% of the "New" Analyst's samples for 1-2 weeks, followed by 75% re-analysis for an additional 2-3 weeks.

7.3.2 The Quality Manager then selectively QC’s >10-50% of the “New” Analyst’s samples for approximately 4-6 weeks, until such time that the “New” Analyst exhibits an error rate of 0% to <1.5% for samples that have been re-analyzed by an experienced analyst.

7.4 After the new analyst successfully completes the training, the Lab Director will issue an authorization letter to the new analyst stating that the new analyst is competent in analysis of bulk samples for asbestos using PLM and his/her samples are subject to ECEI's regular QC analysis. This authorization shall be signed, dated, and filed for future references.

7.5 Continued mentoring is provided to "New" Analysts following the formal training period until such time as they are analyzing at a production level consistent with laboratory expectations and they maintain a three-month error rate below 0.25%. During this time, "New" Analyst's reports undergo technical review from qualified Senior Analyst reviewers and their samples are re-analyzed as QC samples at a rate of 20%.

7.6 The Quality Manager evaluates the training program after each new analyst is authorized to analyze commercial samples. The effectiveness of the training program is in part measured by whether or not a new analyst maintains a controllable, in range (<1%) error rate.

7.7 After initial training is completed, analysts shall undergo continuing education training on an annual basis. This shall consist of at least 8 hours of activity annually. This can include reading literature, attending conferences, attending seminars or webinars, or attending lectures by guest speakers on a topic pertaining to the field.

8.0 Microscope Alignment

8.1 The following should be performed daily, or as needed, to ensure the analysis is performed with the optimal resolution possible:

8.1.1 Center the Sub-stage Condenser.

8.1.1.1 Place a specimen (sample) on the microscope and observe the specimen at 100 power;
8.1.1.2 raise the sub-stage condenser lens to the "up" position;
8.1.1.3 close the field iris;
8.1.1.4 raise or lower the sub-stage condenser apparatus to focus the field iris image;
8.1.1.5 once focused, center the field iris image over the reticule cross-hairs;
8.1.1.6 open the field iris to edge of the field of view;
8.1.1.7 re-center the field iris image if not centered;
8.1.1.8 open the field iris so the image extends just beyond the field of view.

8.1.2 Center the rotating microscope stage to the 10x objective.

8.1.2.1 place specimen on microscope, focus, and search for a small round particle;
8.1.2.2 the analyst then manipulates the slide so the small particle is underneath the cross-hairs of the reticule;
8.1.2.3 the analyst rotates the stage a full 180 degrees;
8.1.2.4 if the particle comes off of the cross-hair, the analyst must use the *stage centering screws* to bring the particle linearly half-way back to the cross-hairs of the reticule;
8.1.2.5 manipulate the slide manually so that the same particle is under the cross-hairs of the reticule,
8.1.2.6 rotate the stage a full 180 degrees, if the particle is stationary on the cross-hairs of the reticule, the stage is centered;
8.1.2.7 if the particle comes off of the cross-hairs, repeat steps 8.1.2.1 to 8.1.2.6 until the stage is centered.

8.1.3 Center the remaining objectives (40x, 20x, 10x dispersion staining) to the rotating stage.
8.1.3.1 For each objective place specimen on microscope, focus, and search for a small round particle;
8.1.3.2 the analyst then manipulates the slide so the small particle is underneath the cross-hairs of the reticule;
8.1.3.3 the analyst rotates the stage a full 180 degrees;
8.1.3.4 if the particle comes off of the cross-hair, the analyst must use the *objective centering screws* to bring the particle linearly half-way back to the cross-hairs of the reticule;
8.1.3.5 manipulate the slide manually so that the same particle is under the cross-hairs of the reticule,
8.1.3.6 rotate the stage a full 180 degrees, if the particle is stationary on the cross-hairs of the reticule, the stage is centered;
8.1.3.7 if the particle comes off of the cross-hairs, repeat steps 8.1.3.1 to 8.1.3.6 until the stage is centered.

8.1.4 Center the central stop of the 10x dispersion staining objective.
8.1.4.1 With a specimen on the stage, switch to the 10x dispersion staining objective;
8.1.4.2 Place the sub-stage condenser lens in the “down” position;
8.1.4.3 Open the achromat on the sub-stage condenser all the way;
8.1.4.4 Insert the Bertrand lens to observe the focal plane of the central stop;
8.1.4.5 Close the achromat;
8.1.4.6 If the image of the central stop completely covers the image of the achromat, the central stop is centered.

8.1.4.7 If the central stop does not cover the image of the achromat, use centering tools to adjust the central stop until this occurs.

8.1.4.8 The analyst may remove the Bertrand lens one this has been accomplished.

8.1.5 Ensure polarizing lenses are at a 90° angle to one another.

8.1.5.1 Place a specimen on the stage;

8.1.5.2 Remove the 530-550nm wave retardation plate;

8.1.5.3 Move the microscope analyzer to the “in” position;

8.1.5.4 Adjust the lower polarizing lens until the field is the darkest it can possibly become;

8.1.6 Ensure the reticule cross-hairs are aligned with the polarizing lenses.

8.1.6.1 Place a specimen of Anthophyllite from Reference Material 1867 Uncommon Asbestos in an HD1.605 refractive index oil on the stage and observe the specimen with the analyzer in the “in” position, and the 530-550nm wave retardation plate in the “out” position.

8.1.6.2 Observe the extinction angle of the anthophyllite; if it does not go extinct parallel to the reticule cross-hair lines, adjust the ocular until extinction parallel to the cross-hairs occurs.

8.1.7 Analysts document that the alignment procedures have been performed on a daily basis on the Daily Analyst Record Worksheet.

9.0 Sample Analysis (EPA 600)

9.1 Bulk sample analysis follows procedures set forth in 40 CFR, Chapter 1 (7-1-87 Edition), Part 763, subpart F, Appendix A, pages 293-299. Where applicable, procedures from EPA/600/R-93/116, *Method for the Determination of asbestos in Bulk Building Materials*, have been incorporated. No alternative methods shall be used without the approval of the Laboratory Director.

9.2 Stereoscopic Examination of Materials

9.2.1 All bulk asbestos samples are to be analyzed under a HEPA filtered hood with an airflow calibrated to at least 75 ft/minute.

9.2.2 A preliminary visual examination using a stereomicroscope is mandatory for all samples, but in itself does not provide positive identification of asbestos.

9.2.3 Each sample is carefully inspected for homogeneity, color, and fibrous and non-fibrous materials. This information, along with a brief description of the sample and the estimated suspect asbestos percentage of the sample is entered on the analyst Laboratory Worksheet. Any discrete layers of the sample should be analyzed and reported separately, consistent with the most current EPA guidelines.

9.2.4 Stereoscope Magnification is increased as needed to confirm the presence or absence of suspected asbestos fibers. Fibrous bundles are isolated for Polarized Light Microscopy (PLM). Non-friable samples may require crushing with a mortar and pestle.

9.3 Polarized Light Microscopy

9.3.1 Fibers and fibrous bundles are isolated, stripped of any interfering material, and finally placed in an oil mount of refractive index as deemed appropriate by the analyst. If no fibers are visible, representative samples of the material are crushed and mounted in refractive index oil. The oil-mounted fibers are examined utilizing techniques outlined in the EPA "Interim Method" (document "EPA 600/M4-82-020"), and the EPA "Test Method" (document "EPA 600/R-93/116").

9.3.2 In Polarized Light Microscopy (PLM), a light microscope equipped with two polarizing filters is used to determine the optical properties of fibers and matrix materials in a bulk sample. These properties are then used to determine the refractive indices of materials relative to specific crystallographic orientations. In this manner, it is possible to distinguish possible asbestos components from others occurring in the sample.

9.3.3 Initial PLM examinations are made at 100X magnification. Examination at higher power, or by dispersion staining objectives may be required. Characteristics of the sample are noted on the Laboratory Report along with a visual estimate of the relative proportions of each material present. Visual estimation is calibrated by the use of Quality Control samples and by point count techniques.

9.3.4 Any discrete layers are reported separately on the analyst's Laboratory Worksheet. Percent asbestos will be estimated for each layer of a sample and a total-percent-asbestos (based on a composite of the sample) will be reported for samples that require a composite result.

9.3.5 The detection limit for PLM analysis is a function of the amount of material examined, the size of asbestos fibers present, the nature of any matrix materials and sample preparation.

9.3.6 Positive identification of asbestos requires the determination of the following optical properties: morphology, color, pleochroism, refractive indices, birefringence, extinction characteristics, sign of elongation, and trace amounts should be identified as either asbestos or as non-asbestos. All optical properties listed above should be recorded for any component identified as asbestos.

9.3.7 Visual area estimates are based on a minimum of three slide mounts.

9.3.8 Trace amount of asbestos may be reported if the following conditions are met: 1) five or more positively identified asbestos fibers above laboratory's blank level are observed; 2) these fibers are spread over three or more slides; 3) no point landed on an asbestos fiber during the point count analysis.

9.3.9 For materials that are friable, and contain less than 10% asbestos by a calibrated visual estimation, a point count will be performed (at an increased cost), if the customer requests it.

9.3.10 Point Counting is accomplished using a Chalkley or cross-line reticule. The analyst will count a minimum of 400 nonempty points, encountered at the intersection of the cross-line during a series of random traverses through a maximum of eight slides at fifty points per slide to a minimum of two slides with 200 points per slide. The analyst will count any asbestos fibers which are among those 400 points, and the total percent asbestos will be the number of asbestos points divided by the total number of points (400). If no asbestos fibers are observed, the analyst will report "Asbestos not detected. (ND)" If the number of asbestos points counted $\leq$ three, the sample may be described as having "<1% asbestos". If the customer requires a specific percentage (i.e. even for samples with <1% asbestos), the percentage will be calculated to two significant digits. When a count is completed and asbestos is detected, but does not fall under a non-empty point, the sample should be reported as <0.25%.

9.3.11 For samples in which the fibers are heavily coated with tar or mastic that hinders analysis, using the following procedures:

9.3.11.1 Place a representative amount of sample on a slide;
9.3.11.2 Use a few drops of HD1.550 refractive index liquid to dissolve the binder;
9.3.11.3 Use forceps or needles to pick out the resulting fibers and put on a new slide;
9.3.11.4 Add 1.550 R.I. liquid and repeat steps 2 and 3 till the fibers are clean;
9.3.11.5 Mount the fibers for PLM analysis.

9.3.12 For samples in which the fibers are coated with calcite, gypsum, or titanium oxide, using the following procedures for analysis:

9.3.12.1 Place a representative amount of sample on a slide;
9.3.12.2 Place a few drops of dilute Hydrochloric Acid on the sample to dissolve or loosen binder;
9.3.12.3 Remove a few fibers from the dissolved sample with forceps and place them on a clean slide;
9.3.12.4 Dry the fibers on a hot plate, then mount with appropriate R.I. liquid for PLM analysis

9.3.13 For non-friable cementitious samples, using the following procedures for sample analysis:

9.3.13.1 Use a hammer or anything equivalent to force the sample to break into pieces;
9.3.13.2 Pick up a few selective pieces of sample using tweezers and put in a pre-cleaned mortar;
9.3.13.3 Grind the sample into fine pieces with a pestle;
9.3.13.4 Use pencil eraser or custom tool to spread the powders on a slide for PLM identification;

9.3.14 For floor tile sample analysis, using the following procedures:

9.3.14.1 Using sharp tweezers or scalpel to obtain a representative tile sample;
9.3.14.2 Add a drop of R.I. liquid on top of the sample and make sure that the sample is immersed in the liquid
9.3.14.3 Heat the sample on a hot plate for a few minutes to dissolve the sample
9.3.14.4 Use pencil eraser or custom tool to smear out the sample evenly so that the asbestos fibers are exposed

9.3.15 Measure and record at least one optical property for non-asbestos fibers that serves to distinguish them from asbestos.

9.3.16 Opinions and Interpretations of data (those not based on known factual data) must clearly be marked as the analyst's opinion or interpretation. This is to be recorded in the "notes" section for that sample on the bench worksheet.

9.3.17 To ensure the accuracy of determined refractive index of each asbestos fiber, good temperature control of the laboratory is necessary. Therefore, a NIST or ISO 17025 traceable thermometer shall be used to record temperatures in the laboratory twice a day, once in the morning and once in the afternoon. The readings shall be recorded and kept. If the temperature conditions jeopardize the results of test, analysis shall be stopped immediately until the problem is corrected.

9.3.18 The nature of asbestos PLM analysis may preclude rigorous, metrologically and statistically valid calculation of uncertainty of measurement. However, the lab shall at least attempt to make a reasonable estimation based on point count method. The estimated uncertainties shall not be higher than the suggested acceptable errors for PLM analysis by EPA/600/R-93/116 method Table 1 lists some causes of uncertainty and how the laboratory seeks to minimize the uncertainty of measurement. These uncertainty estimates shall be reviewed and revised at least monthly to reflect the most recent point count data. Preferably, the estimates shall be attempted for three different percentage ranges, e.g., <1%, 1-10%, >10-50%, and >50%.

Table 1: Minimizing Uncertainty

Action	Procedure to Minimize Uncertainty
Cross contamination in transit to laboratory.	Careful examination of received samples to accept or reject based on missing samples or damaged sample containers.
Insufficient quantity of material.	The analyst rejects the sample and notes the insufficient quantity in the final report.
Refractive Index Liquid Contamination	Analysts investigate RI liquids daily to see they are free from debris. Analysts may use syringes to dispense RI liquids to the samples. Blanks for each liquid used are performed daily with an NaCl standard.
Accuracy	Monthly, analysts read randomly assigned NVLAP samples that have control limits and reference values. The laboratory also creates internal lab control limits for these samples.
Precision	Monthly, a precision value is calculated for each analyst to insure reproducibility of results.

Refractive Index Liquid Reliability	Refractive index liquids are calibrated at least quarterly to insure liquids are within the acceptable range for which to do analysis. Those that are not in the acceptable range are terminated from use.
Reproducibility of Results	10% of all samples are Replicated(by the original analyst) or Duplicated (by a second analyst) in order to determine the reproducibility of results. Errors are assessed and corrective actions taken on those analyst's that fail the test.
Non Friable Organically Bound Material	The sample is dissolve in oil or submitted for a gravimetric process to enhance quantitation.
Friable Particulate Obscures Field of View	Acid dissolution may be used to enhance quantitation of the material. If the material is not acid soluble multiple mounts are made in thinner cross sections.
Fibers of varying size	Multiple reference standards and visual aids are available in the lab to calibrate area and volume percentages.
Cross Contamination in the analysts work area.	Analysts only handle materials in their negative air flow hoods, thus reducing contamination of small airborne particulate. Areas where asbestos containing materials are used are wiped with damp cloths frequently.
Damaged Equipment	Microscopes and lighting sources are assessed by the analyst daily to determine if they are functioning properly. Damaged instruments are immediately repaired or adjusted for optimal performance.
Improper Preparation Techniques	Analysts are investigated upon hire or training to determine if they can adequately prepare and analyze a variety of material types.

9.3.19 When gravimetric analysis is required, appropriate sample treatment such as combustion of samples (ashing) and/or acid dissolution is necessary.

9.4 Procedure for Gravimetric Reduction

9.4.1 When gravimetric reduction is requested or required, appropriate treatment such as ashing and/or acid dissolution must be performed.

9.4.2 Weight reduction by ashing:

9.4.2.1 Weigh an empty crucible. Record weight. **(EC)**

9.4.2.2 Add between 0.200 and 0.500 grams of sample material to the crucible. Record weight of sample and crucible. **(SC)**

9.4.2.3 Subtract EC from SC, this is the TOTAL SAMPLE WEIGHT. **(TW)**

SC-EC=TW

9.3.2.4 Cover crucible with aluminum foil and put in muffle furnace. Using tongs. Combust the sample for 6-8hrs at 480 degrees Celsius.

9.3.2.5 Remove ashed sample from muffle furnace using tongs. Place in desiccator to cool. When sample is cool, remove aluminum foil, and weigh the crucible containing the ashed sample. Record weight. **(AC)**

9.3.2.6 Determine the percentage the ORGANIC MATERIAL is of the total sample.

[(SC-AC) / TW)] x 100 = Percent Organic Material. (%OM)

9.3.2.7 If necessary, the remaining sample may be sent for further weight reduction by acid dissolution (continue procedure at Section 9.4), or the remaining ash may be analyzed to determine asbestos content.

9.3.2.8 If acid dissolution is deemed unnecessary. Analyze the the ash of % asbestos **(%AA)** using PLM by calibrated visual estimate or by point count.
AC-EC=Weight of remaining Ash (RA)

9.3.2.9 Calculate Total Asbestos percent **(%TA)** in the sample by the following calculation:

%TA= %AA x (RA / TW) x 100

9.3.2.10 Record percentages of ORGANIC MATERIAL **(%OM)**, TOTAL ASBESTOS **(%TA)** AND ASBESTOS TYPE, NON-ASBESTOS RESIDUE **(%NAR)**, and TOTAL WEIGHT (g) **(TW)** on the final report.

9.4.3 Weight reduction of remaining ash by acid dissolution.

9.4.3.1 If an additional weight reduction is determined necessary, stop after Section 9.4.3.5 (Weight reduction by ashing) and continue from this point forward.

9.4.3.2 Obtain a 47mm 0.45um pore size polycarbonate filter and place in a self-locking petri dish. Record weight of filter and petri dish. **(FP).**

9.4.3.3 Add 5ml of dilute HCL (4N) to the crucible containing ashed sample. Place crucible in ultrasonic bath for 10-20 minutes.

9.4.3.4 Place the pre-weighed Filter in the Filtration apparatus and turn the vacuum pump on. Using a water bottle, add enough distilled water to filter to make it completely wet.

9.4.3.5 When sonication is complete pour contents into filtration apparatus. Using a water bottle, rinse crucible with distilled water until contents of crucible are completely in the filtration apparatus.

9.4.3.6 Run vacuum pump until the liquid moves completely through the filter.

9.4.3.7 Using forceps, touching only the edge of the filter, pull filter with the residue into pre-weighed petri plate.

9.4.3.8 Dry the sample in a drying oven at <75°C until sample is completely dry.

9.4.3.9 Weigh the petri plate, filter and sample, and record weight. **(FS)**

9.4.3.10 Analyze residue by PLM to determine the asbestos percent by Calibrated Visual Estimate or Point Count. This is the Asbestos Percent in the residue. **(%AR).**

9.4.3.11 Calculate the Percent the Residue Material **(%RM)** using the following equation:

%RM = [(FS-FP) / TW] x 100

9.4.3.12 Calculate the percentage the acid soluble material **(%ASM)** is of the total sample using the following equation:

%ASM = 100 - %RM - %OM

9.4.3.13 Calculate the TOTAL PERCENT ASBESTOS **(%TA)** in the sample using the following equation:

%TA = (%RM x %AR) / 100

9.4.3.14 Calculate the PERCENT ACID INSOLUBLE NON-ASBESTOS MATERIAL **(%AI)** using the following equation:

%AI = %RM-%TA

9.4.3.15 The following data will be recorded on the final report.

PERCENT ORGANIC MATERIAL **(%OM)**
PERCENT ACID SOLUBLE MATERIAL **(%ASM)**
PERCENT ACID INSOLUBLE NON ASBESTOS **(%AI)**
PERCENT TOTAL ASBESTOS AND ASBESTOS
TYPE(S) IN SAMPLE **(%TA)**
TOTAL WEIGHT (g) **(TW)**

9.5 "Asbestiform" at ECEI is defined as length/width aspect ratio of greater or equal to 10:1. Table 2 should be used to identify asbestos.

9.6 Table 3 shall be used to distinguish non-asbestos fibers from asbestos fibers.

Table 2: Asbestos Fibers and Their Distinguishing Characteristics

Mineral	Morphology and Color	Refractive Indices	Birefringence	Extinction	Sign of Elongation
	Wavy fibers. Splayed ends	α: 1.532-1.549	0.004-0.017		

Chrysotile	and "kinks". Colorless.	γ: 1.545-1.556		Parallel	+
Amosite	Straight to curved, rigid fibers. Colorless to brown. Non or weak pleochroism	α: 1.663-1.686 γ: 1.696-1.729	0.021-0.054	Usually parallel	+
Crocidolite	Straight to curved, rigid fibers. Blue to dark blue in color. Pleochroic.	α: 1.654-1.698 γ: 1.666-1.712	0.003-0.022	Usually parallel	—
Anthophy-llite	Straight to curved fibers and bundles. Colorless to light brown.	α: 1.606-1.648 γ: 1.626-1.670	0.013-0.028	Always Parallel	+
Tremolite	Straight to curved fibers and bundles. Colorless to pale green.	α: 1.603-1.620 γ: 1.627-1.642	0.017-0.028	Parallel to oblique	+
Actinolite	Straight to curved fibers and bundles. Colorless to pale green.	α: 1.620-1.667 γ: 1.642-1.686	0.017-0.028	Parallel to oblique	+

Table 3: Non-asbestos Fibers and Properties that Distinguish them from Asbestos

Non-asbestos fiber	Morphology and Color	Refractive Indices	Birefringence	Extinction	Sign of Elongation
Cellulose	Flat, ribbony fibers of variable width with cell walls and holes.		High	Undulose	+
Fibrous Glass	Clear fibers of uniform width		None	Isotropic, 100% extinct.	N/A
	Straight, blocky		Mod. to High	Oblique	Both

Wollastonite	fibers				+ & -
Synthetic	Straight or curvy fibers usually of uniform width, usually will not break into smaller fibrils.		Mod to High.	variable	+ or -
Brucite	Straight, colorless brush-like fibers.			Parallel to oblique	Both + & -
Polyethylene	Curved fibers and bundles. Colorless. Melts with applied heat.		Low to Mod	Parallel to oblique	+
Talc	Straight, needlelike fibers.	<< 1.590 both parallel and perp.	Low to Mod	Parallel to oblique	+

10.0 Standard Work Procedures

10.1 Routine Laboratory Maintenance

10.1.1 The laboratory station is to be cleaned and non-ACM trash disposed of at the end of each workday.

10.1.2 Analyst and login workstations are to be thoroughly cleaned using a HEPA vacuum at the end of each workday.

10.1.3 After QC samples for a project are completed, the samples must be stored for a minimum period of 30 days. Bulk samples analyzed that workday are to be double-bagged in gallon size re-sealable baggies or equivalent and placed in the 30+ gallon sample storage bins.

10.1.4 Individual samples may only be removed from their container and handled in a negative airflow hood pulling the appropriate volume of air.

10.1.5 Individual sample containers are stored in a larger container (self-locking baggie) for all the samples in that sample batch. Sample batches are stored in a larger container (6 mil Garbage bag inside a polyethylene bin) for each analyst, prior to disposal.

10.2 Storage and Disposal of Asbestos-Containing Material (ACM)

10.2.1 Bulk samples submitted to our laboratory are considered to be asbestos containing material (ACM) and are handled accordingly. After laboratory analysis, bulk samples are double-wrapped in 6-mil polyethylene bags and stored in 30+ gallon plastic trash bins, one bin for each analyst.

10.2.2 Bulk samples are stored in the laboratory. Before removal from the laboratory, samples and asbestos waste will be placed in disposal bags that have clearly labeled asbestos warnings. After 30 days, samples are disposed of at an EPA approved dumpsite or returned to the client upon request.

10.3 Calibration of Equipment and Standards

10.3.1 It is the responsibility of the Laboratory Director to ensure that equipment is properly maintained, and is in good working order at the start of each workday. However, on a practical level all laboratory personnel are actively involved in the calibration and maintenance of polarized light microscopes, stereoscopes, and refractive index liquids.

10.3.2 All calibrations and results of all calibrations performed at ECEI Labs are traceable to National Institute of Standards and Testing (NIST) or ISO 17025 standards. Those calibrations that are not directly traceable are calibrated according to consensus standards. For example, the Cargille glass standards used to calibrate oils are not standards from NIST; however, the oils can be confirmed as accurately calibrated by placing NIST asbestos standards in the oils and observing that the correct optical properties for those standards are present. The laboratory only uses thermometers with an NIST or ISO 17025 traceable certificate.

10.3.3 Calibration of Polarizing Light Microscopes - Microscopes found to be defective or malfunctioning must be returned to the distributor for repair or adjustment. Microscopes returning from the distributor will be checked before being placed into service to verify that it is working properly.

10.3.3.1 Polarizing Light Microscope: The polarizing light microscope will be adjusted by the analyst any time they suspect it has become misaligned or is out of calibration. The procedure outlined in Section 8.0 of this manual, must be used to align the microscope.

10.3.3.2 Lenses on polarizing light microscopes are cleaned regularly and as needed to obtain optimal visibility of the sample specimens.

10.3.3.3 Any other adjustment required (i.e. changing the light bulb) or repairs required are to be recorded in the Equipment manual, and the Laboratory Quality Manager will be notified.

10.3.3.4 During the day, the analyst shall periodically perform intermediate checks to maintain confidence in the calibration status of the equipment. These checks shall be carried out according to the above procedures.

10.3.4 Magnifying Stereoscopes - Stereoscopes require little calibration other than ensuring that they focus properly and that the lenses are cleaned daily. Any problems with the stereoscopes should be referred to the Laboratory Quality Manager.

10.3.5 Analytical Balance - The analytical balance shall be calibrated using standard weights at least 4 times per year in the laboratory. A contractor from an analytical balance service company shall maintenance and calibrate the balance once per year.

10.3.6 Muffle Furnace: The muffle furnace shall be calibrated quarterly using a general-purpose thermometer that is measurable to 500° C. This is done to ensure that the temperature of the muffle furnace does not exceed 500° C during the reduction of combustible matrixes.

10.3.7 Calibration of Refractive Index Liquids

10.3.7.1 Refractive index liquids are not stored in direct sunlight or near heat sources which may accelerate their decomposition. The condition of asbestos-relevant R.I. liquids will be checked at least on a quarterly basis.

10.3.7.2 Any new bottle of Refractive Index Liquids will be calibrated when opened.

10.3.7.3 Refractive index liquids are to be calibrated using the following method: “Refractive Index Liquid Calibration using Optical Glass Standards”, by Shu-Chun Su,Ph.D.

10.3.7.4 The optical glass standards to be used for calibration are the set of Cargille M-7 Reference Set available in the laboratory. The oils will be calibrated with an accuracy of 0.004 and at an ambient temperature range of $22^{o}C + 1^{o}C$.

10.3.8 Use of Reference Standards/Materials

10.3.8.1 ECEI analysts shall use NIST or ISO 17025 traceable reference standards or materials, such as NIST Standard Reference Material 1866 (common) and 1867 (uncommon) to perform calibrations. Cargille M-25 Reference Set Precision Calibrated Optical Glass (cat. # 34225) is used to calibrated refractive index liquids.

10.3.8.2 There are no NIST traceable asbestos testing samples. However, past NVLAP samples shall be used routinely by ECEI analysts to improve their analytical accuracies. In combination with past NVLAP samples, point count method shall be used to determine uncertainties of routine asbestos analysis.

10.3.9 Safe Handling of NIST Standard Reference Material - NIST Standard reference materials 1866 (common) and 1867 (uncommon) are kept in a library in the laboratory. If someone wishes to use the Standards, precision Calibrated Optical Glass (cat. #34225), or either of the two sets of Cargille refractive index oils he/she must use the following procedure:

10.3.9.1 Containers of standard reference material are to be opened *only* in areas designated for asbestos analysis, (i.e. only inside of a fully functional negative air flow hood pulling the appropriate volume of air).

10.3.9.2 Transport to and from the Library to the analyst's workstation will occur only if the reference containers are tightly sealed and the outside of the container is clean.

10.3.9.3 The analyst is only to touch standard reference materials with clean analytical instruments, and the analyst will clean their analytical instruments between switching from one standard to another.

10.3.9.4 The dates and times of use of the Standard Reference Materials will be recorded in a specific location in the lab, and then stored as a historical record at some time thereafter.

10.3.10 Calibration of Laboratory Thermometers

10.3.10.1 Workstation thermometers are calibrated at least 4 times a year with an NIST or ISO 17025 traceable liquid thermometer.

10.3.10.2 Temperatures are recorded in degrees Celsius (°C)

10.3.10.3 To calibrate, the temperature is read at a distance of 0, 1, and 3 feet away from the workstation thermometer. The average of the three readings will be taken. If the temperature exceeds + or - 1°C, the workstation thermometer must be replaced.

10.3.10.4 Each day, analysts record the morning and afternoon temperatures in their record books.

10.3.10.5 The traceable liquid thermometer must be replaced or re-certified by an outside source annually.

11.0 Quality Control Procedures

11.1 NVLAP requires a minimum QA/QC volume of 10% as outlined in the publication NIST 150 & 150-3 "Bulk Asbestos Handbook".

11.2 NVLAP's 10% QA/QC requirement is based on the laboratory's total sample volume at any given point and time and includes replicate QC, duplicate QC, and inter-laboratory QC, analysis of blank QC and NVLAP QA.

11.2.1 Quality assurance analyses are performed regularly covering all time periods, sample types, instruments, tasks, and personnel.

11.2.2 The selection of samples is semi-random, focusing more on positive samples, and when possible, the checks on personnel performance executed without their prior knowledge.

11.2.3 QC samples are analyzed routinely with actual workload, and in an on-going manner.

11.3 Quality Control (QC)

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11.3.2 Duplicate QC: Duplicate QC samples are selected from another analyst's original work load for a second independent analysis. The objective of duplicate QC analysis is to evaluate precision between analysts.

11.3.3 Blank QC: The objective of Blank QC is to verify a contamination-free environment. Blank QC samples are analyzed daily using reagent grade salt and are to be prepared as follows:

11.3.3.1 Grind reagent grade salt in mortar, or crush on a slide with clean instruments;

11.3.3.2 mount with clean tweezers/scalpel on a cleaned microscope slide in refractive index liquid of choice;

11.3.3.3 add clean coverslip;
11.3.3.4 observe PLM plane polarized light; fibers are contaminates;
11.3.3.5 Observe PLM crossed polars; anisotropics are contaminates;
11.3.3.6 determine refractive index.

11.3.4 Inter-laboratory Round Robin: ECEI is actively involved in inter-laboratory round robin programs with a minimum of three other labs. Each quarter four round robin samples are analyzed by each analyst. The results are summarized by a host laboratory. The results may be used to estimate the variation among different labs.

11.3.5 NVLAP Sample Analysis: At least four samples from past NVLAP proficiency testing rounds are analyzed by each analyst each month. The results of the analyses are summarized and compared to NVLAP results and the precision and accuracy of each analyst may be determined.

11.3.6 Alternative Quantitative Methods - Each month, point count analyses and TEM analyses of samples previously found to contain asbestos by the PLM method should be compared and summarized.

11.4 Quality Assurance (QA)

11.4.1 NVLAP Proficiency Testing: NVLAP proficiency test samples will be analyzed by each analyst, although only a single result will be reported to NVLAP. In no case, are NVLAP proficiency samples to be contracted to an outside laboratory. NVLAP test samples will be retained for use as library reference materials.

11.4.1.1 The final data submitted to NVLAP for each round are chosen by a rotation of the analysts. A review of data is performed by the Laboratory Director and the Quality Manager. If the data is not suitable for submission to NVLAP, another analyst's data may be submitted.

11.4.1.2 Results of NVLAP Proficiency Testing exchanges will be recorded on the appropriate bulk worksheets and summarized on monthly QA/QC reports as appropriate. The Quality Manager will compare each analyst's data with the data provided for the samples by NVLAP. The Quality Manager will assess each analyst's results individually and will implement any necessary reviews or training for those analysts found to be deficient in their analysis of each NVLAP Proficiency Testing Round.

11.4.1.3 The primary objective of NVLAP Proficiency Testing is to: (1) evaluate the analytical precision and accuracy of our laboratory on a relative basis; and (2) evaluate individual analyst's performance.

11.4.2 Maintaining a Contamination Free Work Area: Maintaining a contamination free laboratory is an important aspect of our Quality Management System.

11.4.2.1 The laboratory work area and equipment are to be cleaned on a daily.

11.4.2.2 In the event of an accidental ACM spill, the contaminated area should be HEPA vacuumed immediately. Air monitoring will then be used to clear that area.

11.4.2.3 Each analyst is responsible for checking his/her workstations on a daily basis to insure a contamination free environment during sample analysis. These checks will include: visual checks of bench space, petri dishes, sampling instruments, tweezers, glass slides, microscope stages, etc.

11.4.3 Ambient Air Monitoring: Ambient air monitoring will be performed in the laboratory on at least a semi-annual basis to verify laboratory cleanliness.

11.4.3.1 Sampling pumps may be placed at sampling work stations and also at representative points in the laboratory.

11.4.3.2 Air sampling volumes should exceed 240 liters for personal pumps and 1200 liters for high volume air pumps.

11.4.3.3 Samples are analyzed for fiber counts using the NIOSH 7400 method and phase contrast microscopy. Results are included in the Monthly QA/QC Report.

11.4.4 Blank QC Analysis: Each analyst is also responsible for analysis of Blank QC samples by preparing a sample of each common RI Liquid (1.550HD, 1.680HD, and 1.605HD) in a mount with reagent grade NaCl.

11.4.4.1 Blank QC samples will be analyzed at the beginning of each work day, or more often if deemed necessary.

11.4.4.2 If a Blank QC analysis is contaminated, the data from that entire sample lot will be considered invalid.

11.4.4.3 In cases where blank QC analysis indicates outside contamination, the Laboratory Director and/or Quality Manager is to be immediately notified.

11.4.5 Resolution of Discrepancies: The Quality Management standard for asbestos bulk analysis at Eurofins CEI, Inc. is as follows:

11.4.5.1 False positives and/or false negatives are always considered significant discrepancies.

11.4.5.2 The In-house standards for "outliers" for estimates of asbestos content are as follows:

11.4.5.2.1 In cases where Analyst 1 reports asbestos contents of <25%, the QC result reported by Analyst 2 will not exceed ±10%.

11.4.5.2.2 In cases where Analyst 1 reports asbestos contents of >25%, the QC result reported by Analyst 2 will not exceed ±25%.

11.4.5.3 In cases where asbestos percentages reported by Analyst 1(Original) and Analyst 2 (QC) significantly differ, the sample will be considered as an "outlier the sample in question will be reanalyzed by Analyst 1, Analyst 2, and a third party, if necessary to determine the "correct" asbestos percentage for that particular sample.

11.4.5.4 Discrepancies between Analyst 1 and Analyst 2 (QC) including false-positives, false-negatives and "outliers" will be promptly resolved by reanalyzing the samples in question. Corrected values will be determined and results discussed with the analysts. An attempt will be made to evaluate and correct the source of error such that the same mistake is not repeated in the future. If an analyst is identified as having a problem with a particular type of analysis, extra time and training may be required to assist that individual.

11.4.5.5 The analyst is responsible for initiating corrective action (i.e. calling the customer and generating amended reports) for his/her own errors. This process is supervised by the Quality Manager. The Quality

Manager or a designee may initiate corrective action for any analyst not present when an error is discovered.

11.4.5.6 In cases where a false positive or negative was initially reported, and an amended report needs to be generated, the client will be notified in writing that a mistake was made. A corrected copy of the test report will be immediately forwarded to that client and all parties involved. Customers will not be notified for QC "outlier" discrepancies.

11.5 Summary of Monthly QA/QC Data

11.5.1 QA/QC data for each Analyst including Blank QC analysis, Replicate QC analysis, Duplicate QC analysis, inter-laboratory QC analysis, and NVLAP Proficiency Test data are summarized on a monthly basis by the Quality Manager and reviewed by the Laboratory Director. Monthly QA/QC results are discussed with staff in a formal meeting each month. Any deficiencies noted will be recorded and resolved immediately. The deficiency corrections for each analyst shall also be included in his/her personnel files.

11.5.2 Laboratory Quotas - No daily laboratory quota is required at ECEI Labs. Analysts are cautioned to take the extra time they may need to ensure quality analyses and to obtain second opinions on difficult or unusual samples.

11.5.3 Individual Analyst Review - An analyst's precision, accuracy and total failure rate are evaluated statistically each month as summarized in Analyst Monthly Review.

11.5.4 A replicate analysis of an actual sample submitted at a later date as a blind will be used to calculate percent range **(R%).**

11.5.4.1 **R%= (X1-X2)/(X1+X2) * 200**

Individual Analyst Review (Cont'd)

where **R% - percent range;**
X1 - first measurement;
X2 - second measurement.

11.5.4.2 The R% will be plotted on a QC chart with limits being determined from a calculation of standard deviation **(SD).**

SD = {sum (R%-R %)2/ (N-1)}0.5

where **R% = average of replicate analysis**
N = the number of replicate analysis

11.5.4.3 The control and warning limits can be determined as:

Control Limit = R% + 2.58 SD
Warning Limit = R% + 1.96 SD

11.5.5 An analyst's accuracy will be determined by analyzing previously submitted NVLAP or Library samples as blinds in the daily run of samples.

11.5.5.1 From those data a recovery calculation can be made after which a standard deviation is calculated for that sample.

11.5.5.2 **P = EAV% / AAV% * 100**

where **P is percent recovery, EAV% the estimated asbestos percentage, and AAV% the actual asbestos percentage.**

11.5.5.3 **SD = {sum (P-P)2/(N-1)}0.5**

where **P is the average recovery, N the number of determinations. A control chart can then be generated for each analyst by plotting P with the following limits:**

Warning Limit = P ± 1.96 SD
Control Limit = P ± 2.58 SD

11.5.6 An analyst's monthly total failure rate will be evaluated as the total number of errors divided by the total number of samples that undergo the quality control process.

12.0 Reporting the Results

12.1 Analyst's at ECEI record their observations and results directly into a computer database. ECEI has a laboratory information system developed with Filemaker Pro 17.0 software. Either through direct data entry, or through a series of drop-down menu choices, analysts can record their observations.

12.1.2 In the PLM database, analysts create bench worksheets using the Filemaker Pro Software.

12.1.3 For each batch of samples logged for analysis, the analyst will record the following information:

12.1.3.1 The ECEI employee(s) that analyzed the samples;
12.1.3.2 The date the ECEI employee analyzed the samples;
12.1.3.3 The number of samples the ECEI employee analyzed in the sample batch (for billing and accounting purposes)

12.1.4 For each sample layer, the analyst will record the following information:
12.1.4.1 The customer's unique sample identification number;
12.1.4.2 The ECEI unique sample identification number;
12.1.4.3 The preparation technique(s) used during analysis;
12.1.4.4 Any notes that may help the customer interpret the results.

12.1.5 For each sample layer, the analyst will record the following information obtained by magnifying stereoscopic analysis:
12.1.5.1 A layer identifier in relation to other sample layers;
12.1.5.2 The homogeneity of the sample layer;
12.1.5.3 A brief visual description of the sample layer;
12.1.5.4 Whether or not the sample layer contains fibrous components;
12.1.5.5 A general description of sample layer friability;
12.1.5.6 An estimated percentage of asbestos content;
12.1.5.7 The color of the sample layer analyzed.

12.1.6 For each sample layer, the analyst records the following information on the laboratory bench worksheet: obtained by magnifying stereoscopic analysis and polarized light microscopy:
12.1.6.1 The non-fibrous, non-asbestos components present;
12.1.6.2 The fibrous, non-asbestos components present;
12.1.6.3 The percent the fibrous and non-fibrous, non-asbestos components present that are determined by calibrated visual estimate;
12.1.6.4 A property of each fibrous, non-asbestos material found that distinguishes it from asbestos;
12.1.6.5 The asbestos type(s) present;
12.1.6.6 The percent of each asbestos type present as determined by calibrated visual estimate;
12.1.6.7 A description of morphology, the sign of elongation, pleochroism, birefringence, and extinction type or angle of extinction for each asbestos type present;
12.1.6.8 If no asbestos was present, a record that no asbestos was detected.
12.1.6.9 the temperature at the workstation at the time of analysis,
12.1.6.10 the initials or name of the analyst.

12.2 Generating a Test Report

12.2.1 For each batch of samples submitted to ECEI, a test report must be generated after analysis is complete.

12.2.2 Using Filemaker Pro software, and Adobe PDF software, the analyst generates a draft report that contains the following information:

12.2.2.1 ECEI's address, phone number, and other contact information;
12.2.2.2 The customer's name and address;
12.2.2.3 any batch identifiers or identification numbers provided by the customer;
12.2.2.4 The unique ECEI lab code (in-house batch identifier);
12.2.2.5 Each sample; and its component layers; and their unique sample numbers created by ECEI;
12.2.2.6 The customer's unique sample identification number for each sample reported;
12.2.2.7 color (and any other information that serves to macroscopically identify and describe the sample);
12.2.2.8 a statement to indicate if the sample is inhomogeneous and if sub-samples of the components were analyzed separately;
12.2.2.9 The type and percentage of each non-fibrous, non-asbestos component observed, for each sample layer reported;
12.2.2.10 The type and percentage of each fibrous, non-asbestos component observed, for each sample layer reported;
12.2.2.11 The type and percentage of each asbestos component observed, for each sample layer reported;
12.2.2.12 A statement of "none detected" when asbestos is not present, for each sample layer reported;
12.2.2.13 Any notes generated by the analyst that might help the customer interpret the results;
12.2.2.14 The authorized signature(s) of the ECEI employee(s) that analyzed the sample batch;
12.2.2.15 Any departures from the test method.
12.2.2.13 The test method used to test the samples, and a statement that shows that sample results apply only to the items tested;
12.2.2.14 The date the samples were received by the laboratory;
12.2.2.15 The date the samples were analyzed.
12.2.2.16 A statement that the reports must not be used by the client to claim endorsement by NVLAP, NIST, or any agency of the U. S. Government.

12.2.3 After the draft test report is generated, the test report is submitted to qualified personnel for data review.

12.3 Reporting the Results to the Customer

12.3.1 After the draft test report is approved for submittal to the customer, the draft is submitted to the laboratory support personnel for reporting to the customer.

12.3.2 Using Adobe PDF software, the final test report is generated with the date of reporting to customer included, as well as an electronic scan of the customer's paperwork at the end of the test report.

12.3.3 The electronic test report is delivered to the customer via e-mail or facsimile.

12.3.4 ECEI delivers test reports to its customers that require them by hand, courier, or U.S. Mail.

12.3.5 ECEI delivers customer submitted paperwork to its customers that require them by hand, courier, or U.S Mail.

12.3.6 It is the policy of Eurofins N.A. that all bench worksheets, hard copy records, results of quality control and all electronic records be maintained by the laboratory for a period of five years.

13.0 **Method Validation**

11.1.1 This method was validated by the EPA and adopted by ECEI.

11.1.2 Method reviewed and approved by:

ECEI Laboratory Director: ___________________________ Date: _________
Tianbao Bai, PhD, CIH

ECEI Quality Manager: ___________________________ Date: _________
Emily Morris

11.1.3 Analysts/Technicians: All personnel involved with handling, receipt, preparation, reporting, and review of PLM samples must follow the PLM SOP Manual with regards to whatever involvement they have in the SOP procedures.

11.2.4 Employee Compliance Statement. I have read the *"Eurofins CEI Labs, Inc. SOP 400 "Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy".* I understand and will implement all portions of the SOP that apply to my authorized position.

Tianbao Bai	Date
Candace Burrus	Date
Cassidy Ploch	Date
Greg Ruff	Date
Justin Shu	Date
Kimberly Davenport	Date
Kathryn Wescott	Date
Megan Fisher	Date
Madelyn Schmidt	Date
Nicholas Moore	Date
Nicholas Pallares	Date
Rosalinda Cruz	Date

Regan Kerns Date

Ryan Steele Date

Samantha Card Date

Shilpa Ladekar Date

Scott Minyard Date

Saithya Painkal Date

Valerie King Date

Yvette Nkunde-Bose Date

Zane Heinz Date

Erik Young Date

Connor Bunting Date

Yasmine Ahmed Date

Note: Login/Sample Processing Personnel have an intra-department SOP in which the employees comply with regards to all test types, including PLM.

Additional Employees:

Printed Name Signature Date

Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date

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APPENDIX C

INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN

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C. Investigation-Derived Waste Management

This Investigation-Derived Waste (IDW) Management Plan addresses generic waste collection, characterization, storage, and disposal procedures to be used when implementing additional investigation of asbestos at CC RVAAP-78 Quarry Pond Surface Dump within Camp James A. Garfield (CJAG). Activities are limited to trench excavation, surface soil sampling, and subsurface soil sampling.

IDW includes all materials generated during an investigation that cannot be effectively reused, recycled, or decontaminated in the field. Two types of IDW will be generated during the implementation of field activities: indigenous and non-indigenous. Indigenous IDW potentially generated during field activities includes soil removed for sampling purposes and residual soil samples. Non-indigenous IDW potentially generated includes decontamination rinse fluids, disposable aluminum trays and foil, and compactable and miscellaneous trash (e.g., disposable personal protective equipment [PPE] or investigation-related equipment). Since asbestos in soil and asbestos-containing material (ACM) are being sampled at this site, all contact waste (e.g., gloves, trays, Tyvek® suits, decontamination fluids, plastic sheeting) will be collected and handled as asbestos-containing waste. Procedures used to manage IDW are described below.

All wastes generated during environmental investigations at CJAG will be managed in accordance with Federal and State of Ohio requirements. All waste activities must comply with the CJAG Waste Management Guidelines. All waste disposal, other than municipal refuse, will be coordinated with the Ohio Army National Guard (OHARNG) Environmental Specialist. Wastes characterization will not be required. All containerized wastes will be characterized as asbestos-containing waste.

C.1 INVESTIGATION-DERIVED WASTE COLLECTION AND CONTAINERIZATION

All indigenous solid IDW (soil) from trenching and soil sampling will be placed back into its associated trench. Therefore, it is not anticipated that soil will be placed in containers and disposed of offsite. However, due to the presence of ACM debris and the potential for asbestos fibers to be present in soil, the excavated soil will be handled appropriately following Federal and state U.S. Environmental Protection Agency guidance. Wet methods (i.e., spraying water with amendment) will be used to keep soil sufficiently damp to help prevent dust and fibers from becoming airborne. In addition, excavated soil will be placed on two layers of 6-mil plastic sheeting or one layer of 12-mil plastic sheeting. The stockpiles will also be covered with two layers of 6-mil plastic or one layer of 12-mil plastic to keep soil damp, prevent dust generation, and prevent cross contamination with surface soil.

All solid non-indigenous IDW that is used for asbestos-related work (e.g., gloves, Tyvek® suits, plastic sheeting) will be handled as asbestos waste. These items will be placed in doubled up 6-mil plastic bags and disposed of as asbestos waste. Any solid non-indigenous waste that is not used for asbestos work will be collected and removed as municipal waste. Leidos and its subcontractor will remove any municipal trash it produces from the facility and will not use onsite trash receptacles.

All liquid non-indigenous IDW (e.g., decontamination rinse water, soap, water/water rinses from cleaning equipment and reusable supplies) will be contained in labeled, U.S. Department of Transportation (DOT)-approved, 55-gallon closed-top drums and handled as asbestos-containing waste.

C.2 WASTE CONTAINER LABELING

All containers, including those that are empty, must be properly labeled. All waste storage containers (e.g., drums, asbestos waste bags) will be labeled immediately before and continuously during their use to ensure proper management of the contained wastes. Asbestos disposal bags, which have warning labeling already affixed, will be used. All other labels will be weather-resistant, commercially available labels. One label will be affixed and located on the upper one-third of each storage container. Labels will be legibly completed using indelible ink. The drum number will be legibly recorded directly on a clean dry surface on the top and upper one-third of each storage container using an indelible paint marker. Additional label information may be recorded directly on a clean, dry surface.

An example of the waste storage container label is shown in Figure C-1. An example of an asbestos danger label is shown in Figure C-2. The following procedure will be used for waste container labeling:

- Place label on a smooth part of the container and do not affix it across drum bungs, seams, ridges, or dents.
- Upon use of a container, replace the empty label with an appropriate label filled out with the information listed below.
- Affix the appropriate asbestos hazard label to the container.
- Record the following information on each label:
  - Contractor-assigned container number
  - Contents
  - Source of waste
  - Source location (if applicable)
  - Project name and area of concern (AOC) identification
  - Physical characteristic of the waste
  - Generation date(s)
  - Address of waste generation
  - Contact information for a contractor contact and the OHARNG Environmental Specialist.
- Record all information on container labels with indelible ink (permanent marker or paint pen) and record necessary information in a field logbook or on an appropriate field form.
- Protect all container labels so that damage or degradation of the recorded information is prevented.
- Labels will be photographed when affixed to the container. Photographs will be provided to the OHARNG Environmental Specialist. New photographs will be collected whenever drum status is updated (i.e., pending analysis, final classification).

C.3 INVESTIGATION-DERIVED WASTE STAGING

Subject to the approval of the Army National Guard (ARNG) Program Manager and OHARNG Environmental Specialist, all asbestos-containing waste will be stored at Building 1047. Since access to Building 1047 is limited and must be coordinated, the team may stage collected asbestos waste on a temporary, lined, labeled, and contained decontamination pad until access to Building 1047 is given and the waste can be transferred. Any liquid IDW drums (asbestos decontamination water) will be stored inside Building 1047 on secondary containment pallets. All indigenous (solid) asbestos-containing waste will be stored at Building 1047 until transport and disposal to a licensed asbestos landfill has been coordinated. Since only asbestos-containing waste is anticipated to be generated, no other methods of storage and waste disposal will be necessary.

All non-contaminated, non-indigenous solid IDW that is not used for asbestos sampling (e.g., packing materials, personnel refuse) will be disposed of as municipal trash offsite. Onsite trash receptacles will not be used for non-contaminated, non-indigenous solid waste.

The waste generated during this investigation is expected to be all asbestos-containing waste (i.e., special waste). Generator knowledge and historical sampling data from this AOC suggests that all of the solid and liquid waste generated from sampling activities should be treated as asbestos-containing waste. The soil has been previously sampled and determined to be non-hazardous for all other potential chemical contaminants. IDW staged and stored at Building 1047 is subject to the requirements of CJAG Waste Management Guidelines and must comply with the following:

- An IDW container log will be completed for each 55-gallon drum of IDW (solid or liquid) or other container generated during the investigation. The IDW container log will document the following:
  - Container specific drum number (example provided in Figure C-1)
  - Location of drum staging area
  - Type of material (soil/liquid)
  - Quantity added to drum and date
  - Cumulative quantity of drum and date.
- All contractor waste, including environmental waste pending sampling and pending analysis waste, will be inspected and inventoried weekly. Documentation of the inspection will be recorded on the CJAG weekly waste inventory sheet. This inventory sheet will be submitted weekly to the OHARNG Environmental Specialist. CJAG Waste Management Guidelines, the weekly inspection/inventory sheet, and the waste disposal tracking form are presented in Attachment C-1. Inventory and inspection must include, at a minimum:
  - Inventory of number of containers
  - Inspection of container(s) conditions (no bulging, or rusting)
  - Inspection of labels (all present, correctly labeled, not faded)
  - Date and time of inspection
  - Inspector's name and signature.
- Waste profiles will be signed by the OHARNG Environmental Specialist.
- All waste (except for municipal waste) must be manifested.
- All liquid waste must have secondary containment.
- All contractors must confirm that the disposal facility has received the waste shipments within the required time frames. This will be accomplished by contacting the OHARNG Environmental Specialist to verify that the disposal facility signed and returned a copy of the manifest to CJAG. If the copy has not been returned within 30 days of the pickup date, the contractor must contact the treatment, storage, and disposal facility to inquire and request a copy of the return manifest. If unsuccessful, the contractor must notify the OHARNG

Environmental Specialist and begin corrective actions. A copy of the return manifest must be given to the OHARNG Environmental Specialist for the waste file.

C.4 INVESTIGATION-DERIVED WASTE CHARACTERIZATION AND CLASSIFICATION FOR DISPOSAL

All non-indigenous liquid and solid IDW (e.g., gloves, Tyvek® suits, disposal sampling media, plastic, any water generated from decontamination of trenching and soil sampling equipment) will be treated as asbestos-containing waste and will not be sampled for any other characterization.

Any waste not used for sampling (e.g., packaging materials, personnel refuse) will be placed in trash bags and classified as municipal waste.

After all asbestos-containing waste has been collected, properly containerized, staged at Building 1047, and prior to the disposal of any waste, an IDW Characterization and Disposal Plan will be prepared and submitted to the OHARNG Environmental Specialist, ARNG Program Manager, and the U.S. Army Corps of Engineers (USACE). The IDW Characterization and Disposal Plan will present an inventory of all stored IDW, document the analytical results and IDW characterization, and make recommendations for the disposal of all IDW based on the determined waste classification.

C.5 INVESTIGATION-DERIVED WASTE DISPOSAL

Table C-1 identifies the disposal options for all expected waste streams from environmental investigations at CJAG based on past efforts. Waste disposal options recommended in the IDW Characterization and Disposal Plan are subject to the approval of the OHARNG Environmental Specialist, ARNG Program Manager, and USACE. The OHARNG Environmental Specialist, or designee, will sign all waste manifests and other shipping documents and oversee the disposition of all IDW at CJAG. Transportation of all IDW for storage and/or disposal will be in accordance with applicable Federal and State of Ohio regulations. When IDW will be disposed of offsite, using public roads as a means of transportation, the shipment or transportation of IDW may be subject to DOT requirements for containerizing, labeling, and shipping documentation (49 Code of Federal Regulations [CFR] 172).

There is no means for disposal of contaminated IDW at CJAG. All IDW will be disposed of offsite according to applicable Federal and State of Ohio regulations.

Any liquid IDW that is stored at Building 1047 during the winter will require special management to prevent accidental releases due to freezing. The contractor's foremost responsibility is to manage IDW so that, if possible, disposal can be completed before freezing conditions arise. If disposal cannot be executed before the onset of such conditions, or if long-term storage of liquids is anticipated, secondary containment is required. Secondary containment is the responsibility of the contractor and is subject to the requirements of the Resource Conservation and Recovery Act.

All non-indigenous solid waste not used for sampling (e.g., packaging material, personnel refuse) will be disposed of as municipal trash. All other expendable sampling equipment determined to be potentially contaminated will be placed in the asbestos-containing waste stream.

All treatment, storage, and disposal facilities must be in good standing with environmental regulatory agencies. The OHARNG Environmental Specialist must be notified in advance of waste disposal as to which disposal facility is to be used. The OHARNG Environmental Specialist has the authority to refuse the use of a particular disposal facility based on his/her review of their ability to protect the interests of the Army.

All IDW is disposed offsite at appropriate licensed facilities using public roads as a means of transportation, making the shipment or transportation of IDW subject to DOT requirements for containerizing, labeling, and shipping documentation (49 CFR 172). Therefore, the contractor will comply with all DOT requirements.

Table C-1. IDW Disposal Options for Potential Waste Streams

Waste Stream	Municipal Waste	Asbestos Containing Waste
Solid (asbestos sampling contact waste)	N/A	Dispose of offsite at permitted asbestos waste facility
Liquid (decontamination fluids – water, Liquinox®, Alconox®)	N/A	Dispose of offsite at permitted asbestos waste facility
Expendable trash (not related to sampling activities)	Dispose of as municipal trash offsite	N/A

IDW = Investigation-Derived Waste
N/A = Not Applicable

Figure C-1. Example of Waste Storage Container Label Information

Asbestos-Containing Waste Material

Drum Number: Leidos-MSRD-QPSD-S-001 (for solids), Leidos MSRD-QPSD-L-001 (for decontamination water)

Contents: (Asbestos-containing solids or decontamination water)

Source of Waste: Additional RI Sampling (Quarry Pond Surface Dump)

Source Location: Quarry Pond Surface Dump

Generation Dates: Day/Month/Year

Address: 8451 State Route 5, Ravenna Ohio 44266

Contact: Katie Tait (614) 366-6136, Charles Spurr (216) 317-5726

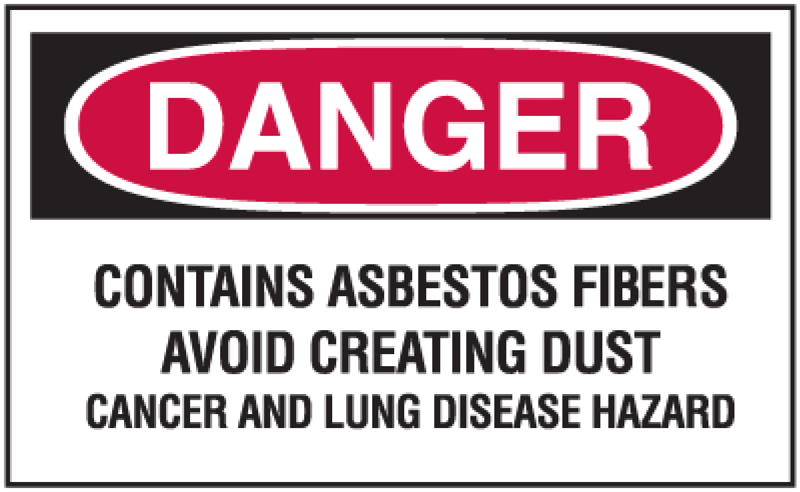
Notes:

The third suffix in the drum number is the abbreviation of the AOC associated with the waste. Waste from the Quarry Pond Surface Dump Area should use QPSD.

Figure C-1 is an example of what information should be used on an asbestos containing waste material label.

IDW = Investigation-Derived Waste
L = Liquid IDW
MSRD = Multi-Site Remedial Design Addendum
QPSD = Quarry Pond Surface Dump
RI = Remedial Investigation
S = Solid IDW

Figure C-2. Example of Asbestos Warning Label



ATTACHMENT C-1

CJAG WASTE MANAGEMENT

- CJAG Waste Management Guidelines
- CJAG Weekly IDW Inspection Sheet
- Waste Disposal Tracker

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CJAG WASTE MANAGEMENT GUIDELINES

PURPOSE: Guidelines to be followed by contractors working at Camp James A. Garfield Joint Military Training Center who are generating/shipping Hazardous, Non-Hazardous, Special or Universal Waste.

POLICY: The policy at CJAG is to comply with all local, state, federal and installation requirements. Contractor is responsible for waste minimization and is required to recycle materials if possible.

Restoration Program POC: Katie Tait (614) 336-6136 Military & Non-Restoration POC: Brad Kline (614) 336-4918

Coordination:

- Coordinate all waste generation and shipments with the appropriate CJAG POC listed above or the Environmental Supervisor in their absence at (614) 336-6568.
- Notify CJAG POC prior to waste sampling for characterization. Details about sampling activities must be included (i.e., number of sample, analyticals, etc.).
- All Hazardous and Non-Hazardous waste management storage locations must be pre-approved prior to generation.
- Ensure all labels include: Date, Contractor, and Waste Type.
- When contractors have waste onsite, a weekly Inspection inventory must be completed and submitted to the appropriate POC in the CJAG environmental office.
- All wastes shall be tracked and logged throughout the duration of the project. Contractor will provide CJAG POC with a monthly rollup report of all waste and recycled streams generated by no later than the 10^{th} day of the following month.

Hazardous Waste Treatment, Storage and Disposal Facilities and Waste Haulers: Contractors are required to utilize hazardous waste haulers and Treatment, Storage, and Disposal Facilities on the latest Defense Reutilization Marketing Office (DRMO) approved list. The current qualified waste hauler and TSDF list can be viewed by following the "Qualified Facilities" and "Qualified Transporters" links found on the DLA Hazardous Waste Disposal Homepage, http://www.dispositionservices.dla.mil/newenv/hwdisposal.shtml.

Hazardous or Non-Hazardous manifest form, the following must be included:

- Military and non-restoration operations waste Site Name = Camp James A. Garfield Joint Military Training Center. Mailing and Site address: CJAG ENV, 1438 State Route 534 SW, Newton Falls, Ohio 44444, (614) 336-4918. Ohio EPA ID # – OHD981192925.
- Restoration Program waste Site Name = Former Ravenna Army Ammunition Plant. Mailing address is same as address above. Site address: 8451 State Route 5, Ravenna, Ohio 44266, (614) 336-6136. Ohio EPA ID # – OH5210020736.
- Contractor's shipping Hazardous Waste must provide a Land Disposal Restriction (LDR) in accordance with 40 CFR Part 268.
- Profiling:
  - The required shipping documentation (i.e. waste profile and executive summary of lab reports (if available)) need to be submitted to appropriate CJAG POC or designee(s) for approval and signature prior to shipping.
  - Results of characterization must be submitted to appropriate CJAG POC within 30 days after collecting sample.
- Manifests - Hazardous and Non-Hazardous:
  - The waste carrier/transporter provides appropriate manifest to the contractor.
  - The contractor is required to:
    - Ensure that CJAG POC or designee(s) is available to sign the manifest on the scheduled day of shipment;
    - Verify that each manifest is properly completed and signed by CJAG POC or designee(s);
    - Provide the Generator copy of the manifest to CJAG POC or designee(s); and
    - Ensure that the original Generator copy of the manifest signed by the treatment storage disposal facility is returned to CJAG within 30 days of the shipping date for Hazardous and Non-Hazardous Waste.
    - The use of a Bill of Lading, in lieu of a waste manifest, must be approved by the CJAG environmental office.

All satellite accumulation storage sites and containers will comply with 40CFR 262.34(c)(1):

- Any material that is subject to Hazardous Waste Manifest Requirements of the US Environmental Protection Agency must comply with 40 CFR Part 262.
- From the time any waste is placed in a satellite storage container, proper labeling must be on the container (proper labeling includes date, contractors name and product type).
- Pending analysis label is to be used from the time the sample is taken until the results are received.
- In no case will waste labeled pending analysis exceed 45 days.

All CJAG Hazardous and Non-Hazardous records are maintained at the CJAG environmental office, point of contacts are Katie Tait at (614) 336-6136 and Brad Kline at (614) 336-4918.

CJAG WEEKLY NON-HAZARDOUS & HAZARDOUS WASTE INSPECTION/INVENTORY SHEET

Contractor: _____________ **Month:** _________________ **Year:** ____________ **Waste Description:** ____________

Container Nos. ____

	WEEK 1	WEEK 2	WEEK 3	WEEK 4
	Date: **Time:**	**Date:** **Time:**	**Date:** **Time:**	**Date:** **Time:**
Point of Contact (Name / Number)				
Project Name:				
Contracting Agency and POC:				
Waste Determination: Pending Analysis, Hazardous, Non-Hazardous, etc.				
*Location on installation:				
Date Generated:				
Projected date of disposal:				
Non-Haz, Satellite, 90 day storage area				
Waste generation site:				
Number of Containers (size / type):				
Condition of Container:				
Containers closed, no loose lids, no loose bungs?	yes / no	yes / no	yes / no	yes / no
Waste labeled properly and visible (40 CFR 262.34 (c) (1):	yes / no	yes / no	yes / no	yes / no
Secondary containment	yes / no	yes / no	yes / no	yes / no
Incompatibles stored together?	yes / no	yes / no	yes / no	yes / no
Any spills?	yes / no	yes / no	yes / no	yes / no
Spill kit available?	yes / no	yes / no	yes / no	yes / no
Fire extinguisher present and charged?	yes / no	yes / no	yes / no	yes / no
Containers grounded if ignitables?	yes / no / na	yes / no / na	yes / no / na	yes / no / na
Emergency notification form/info present?	yes / no	yes / no	yes / no	yes / no
Container log binder present?	yes / no	yes / no	yes / no	yes / no
Signs posted if required?	yes / no	yes / no	yes / no	yes / no
Photos submitted	yes / no	yes / no	yes / no	yes / no
Printed Name:				
Signature:				

This form is required for Non-Hazardous and Hazardous waste including PCB and special waste.

CONTRACTORS ARE REQUIRED TO SUBMIT THIS FORM WEEKLY TO THE CAMP RAVENNA ENV OFFICE WHEN WASTE IS STORED ON SITE.

CONTRACTORS ARE ENCOURAGED TO INCLUDE PHOTOS WITH EACH WEEKLY INSPECTION SHEET WHEN WASTE IS STORED ON SITE.

*Draw detailed map showing location of waste within the site.

-

Construction/Demolition Diversion and Waste Disposal Form/Tracker

Project Title ______________________________ **Project Number** ______________________

Date	Material Type*	Material Description**	Total Quantity of Material	Tons/lbs/CY/each	Total Number of Manifest/Disposal Tickets Attached

***Material Type:** C&D Debris, Recyclable/Reutilized Material, Universal Waste, TSCA Regulated Waste

****Material Description:** C&D Debris (wood, glass, asphalt, concrete, soil, plastic etc…)
Recyclable Material (scrap metal and concrete etc….)
Universal Waste (bulbs, mercury containing devices, used batteries)
TSCA Waste (asbestos, PCB's, lead based paints)

CONTAINER LOG

Container No. [1]

Drum Staging Area: Building 1036

Date [2]	Material Name [3]	Quantity Added [4]	Cumulative Quantity [5]	Person Adding Material [6]	Label	Notes

(When 55 gals total reached, must move from SAA within 3 calendar days.)

Date Container Transferred to Generator Accumulation Area ______________________

Materials shipped offsite date: ______________________

(1) Container ID Number (e.g., FC-FMS#1-2)
(2) Date when waste was added to container
(3) Name of waste added (e.g., Diesel Fuel)
(4) For items such as filters, note the number of items. For liquids, note the number of gallons.
(5) The total quantity of items of numbers of gallon currently in the container
(6) The name of the person adding the waste

APPENDIX D

OHARNG ENVIRONMENTAL PROCEDURES

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D.1 – OHARNG ENVIRONMENTAL PROCEDURES

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OHARNG Environmental Procedures
Restoration Program Specific Version
15 July 2022

1. General

1.1. These Environmental Procedures identify environmental compliance requirements for Ohio Army National Guard (OHARNG) projects. The Environmental Procedures are intentionally broad in scope to ensure contractors have information needed to price and complete work knowing all the requirements. Contractors conducting work not specified in these procedures are considered to be in compliance with no specific action required.

1.2. The Contractor must comply with all applicable local, state, and federal environmental requirements to include applicable Army and OHARNG regulations. This includes, but is not limited to, the proper characterization, management and disposal of wastes; proper storage, use and transportation of hazardous materials; spill prevention and clean up; obtaining proper permits and submitting proper notifications as applicable to the work being conducted; and protection of surface water and natural resources.

1.3. The Contractor (to include subcontractors) will not correspond with any regulatory agency regarding an OHARNG project without approval of the OHARNG. This includes meetings, phone calls, emails, permit/application submittals, or other written or verbal communications. The OHARNG will review and approve all correspondence, to include permit applications and notifications, before they are sent to a regulatory agency to include but not limited to the federal or Ohio Environmental Protection Agency (EPA), the US Fish and Wildlife Service, the Ohio Historic Preservation Office, the US Army Corps of Engineers, County Engineer offices, and local Soil and Water Conservation offices.

1.4. The Contractor is responsible for paying all fees and acquiring all applicable permits or regulatory approvals associated with the work they are performing. Depending upon the permit/notification, it may need to be issued in the OHARNG's name. Coordination will be done with the OHARNG to determine this and as applicable the Contractor will complete the application/notification for OHARNG signature and submit the application and associated fees. All permit submittals will be coordinated, reviewed and approved by the OHARNG before submittal regardless of who signs the application.

1.5. Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*, establishes a federal integrated strategy toward sustainability including efforts to "eliminate waste, recycle, and prevent pollution." Additionally, EO 13693 establishes targets to divert at least 50% of non-hazardous solid waste, including construction and demolition debris, from the waste stream. The Contractor will utilize the most current waste prevention, waste diversion (salvage, reuse, recycle), and waste minimization guidelines to ensure this target is met.

2. Emergency Spill Response and Petroleum, Oil, and Lubricant (POL) Management

2.1. The Contractor must comply with the local OHARNG Spill Contingency Plan and implement appropriate measure to prevent spills/releases to the environment and to respond, notify, and report when a release occurs. The Contractor is required to inspect equipment, fuel, and hazardous materials storage areas to ensure there are no leaks or releases. The Contractor is responsible for implementing spill response and cleanup of all spills/leaks within the project area immediately upon discovery. Clean up must be satisfactory to the OHARNG and/or the Ohio EPA or other applicable regulatory agency. Wastes will be managed as described in the waste management section of these Environmental Procedures.

2.2. The OHARNG will be notified of all spills/releases. Incidental releases (petroleum product less than 25 gallons, a release that stays of OHARNG property, not in water, and not a reportable quantity) will be responded to by the contractor and the OHARNG notified by telephone within 2-hours. Any spill of petroleum products over 25 gallons, a spill that goes off of OHARNG property, a spill of any amount into a body of water, or a reportable quantity release must be reported to the OHARNG **immediately**. All spills/releases must be reported in writing on the OHARNG Spill Report Form (Attachment 1) and submitted to the OHARNG within 24 hours. The Contractor will be provided with a copy of the OHARNG Spill Report Form and a point of contact for submitting such reports/notifications.

2.3. The Contractor is required to have a spill kit with appropriate absorbents, plastic bags, drums, shovels, and other supplies and equipment suitable to clean up any releases or spills from their activities.

2.4. Contractor stationary fuel pods must be in/on secondary containment with a storage capacity of 110% of the container. A double walled container is sufficient secondary containment. Releases of rain water from secondary containment can only be initiated after approval from the OHARNG Environmental Office and after inspection and verification/absorption of all petroleum, oil, and lubricants (POL) and/or other contaminants in the water by the Contractor. Discharge of POL or other contaminants/pollutants from secondary containment is not permitted. At minimum, discharging through an oil only boom/filter or an oil absorption filter bag is required. If the contractor cannot show proof of lack of contaminants, the water will need to be sampled and characterize to determine the proper discharge/disposal method. The contractor will document all discharges/disposal from secondary containments to include name and signature of person conducting discharge/disposal, date of discharge/disposal, volume discharged/disposed, method of discharge/disposal, method of determining water was clean to discharge (analytical result if applicable), and a statement that any discharge did not contain POL or other contaminants. Discharges from secondary containment will be addressed in the Waste Management Section of the Work Plan.

2.5. Individual fuel/POL cans (5 gallon or less) and hazardous materials used on job sites must be stored in a manner that prevents release to the environment. This will usually involve a covered storage area with appropriate secondary containment that protects them from rain and accidental damage. Chainsaw fuel and bar oil on logging jobs can be left at the tree felling site in the woods or brought out to the log landing each day.

3. Erosion Control, Storm Water and Other Surface Water Management

3.1. For all projects, regardless of the disturbance acreage, the Contractor will use all methods appropriate and required to prevent soil from leaving the project site either by wind, water, or on vehicles and equipment. Silt fence and other temporary soil run off detention methods will be used as needed. Spoil piles and disturbed areas will be managed in accordance with the stipulations outlined in the Ohio EPA General National Pollutant Discharge Elimination system (NPDES) Storm Water Construction Permit and the most current version of the Ohio Department of Natural Resources' Rainwater and Land Development Manual; Ohio's Standards for Storm Water Management, Land Development, and Urban Stream Protection (available on-line). The site must be seeded with a temporary seed mix if left idle for the designated period of time. The project site will be closed out by preparing the soil as a seed bed and seeding and mulching with the appropriate seed mix. Temporary erosion control measures (silt fence) will be removed by the contractor once vegetation has been established and soil on the project area is stabilized.

3.2. Native seed mixes will be used and compatible with maintenance requirements. An appropriate turf grass mix will be used for high traffic and high maintenance areas. Annual ryegrass can be added to mixes to provide quick cover. For late season seeding, winter wheat/rye can be added to provide a quick cover. Contractors will use the approved grass seed mixes listed below or propose alternative seed mixes. The OHARNG Environmental Office must approve all seed mixes. The seed mixes that will be used will be identified in the Storm Water Management, Sediment, and Erosion Controls section of the Environmental Work Plan.

The following seed is approved for establishment of temporary cover. Species can be mixed if/as necessary for specific application.

- Annual Rye Grass (*Lolium multiflorum*), broadcast @ 40 lbs/acre, drilled at 30 lbs/acre, mulch with a minimum of 3 bales of straw per 1000 square feet. Use mulch netting or fiber mat on slopes greater than 6%. Grows quickly but of short duration. Good growth during hot summer period.

- Winter Rye (*Secale cereal)* broadcast @ 112 lbs/acre, drilled at 80 lbs/acre, mulch with a minimum of 3 bales of straw per 1000 square feet. Use mulch netting or fiber mat on slopes greater than 6%. Good for fall seeding. Select a hardy variety.

- Oats (*Avena sativa*) broadcast @ 80 lbs/acre, drilled at 65 lbs/acre, mulch with a minimum of 3 bales of straw per 1000 square feet. Use mulch netting or fiber mat on slopes greater than 6%. Best for spring seeding. Fall seeding will die when winter sets in.

- 40% Nodding Wild Rye (*Elymus canadensis*), 40% Virginia wild rye (*Elymus virginicus*), 15% Partridge Pea (*Chamaecrista fasciculata*), and 5% Black-eyed Susan (*Rudbeckia hirta*), broadcast @ 35 lbs/acre, drilled at 25 lbs/acre, mulch with a minimum of 3 bales of straw per 1000 square feet. Add 20 lbs/acre of Annual Rye Grass (*Lolium multiflorum*) to the broadcast mix and 15 lbs/acre to the drilled mix. Good for areas that will remain unfinished indefinitely.

- 23.5% Nodding Wild Rye (*Elymus canadensis*), 25% Virginia wild rye (*Elymus virginicus*), 18.75% Partridge Pea (*Chamaecrista fasciculata*), 1.5% Black-eyed Susan (*Rudbeckia hirta*), and 31.25% Little Bluestem (*Schizachyrium scoparium*), broadcast @ 25 lbs/acre, drilled at 18 lbs/acre), mulch with a minimum of 3 bales of straw per 1000 square feet. Add 20 lbs/acre of Annual Rye Grass (*Lolium multiflorum*) to the broadcast mix and 15 lbs/acre to the drilled mix. Good for late season (after 15 September) quick temporary cover.

The following seed is approved for establishment of permanent cover in areas that are not maintained as turf grass or high foot traffic areas such as range impact areas that are not regularly mowed, roadsides outside of cantonment areas, fence lines outside of cantonment areas, etc. Substitution with similar species is permitted but must be approved by the OHARNG Environmental Office.

- 23.5% Nodding Wild Rye (*Elymus canadensis*), 25% Virginia wild rye (*Elymus virginicus*), 22% Little Bluestem (*Schizachyrium scoparium*), 18.75% Partridge Pea (*Chamaecrista fasciculata*), 7.75% Thin-leaved Coneflower (*Rudbeckia triloba*), 1.5% Brown fox sedge (*Carex vulpinoidea*), 1.5% Black-eyed Susan (*Rudbeckia hirta*), broadcast @ 18 lbs/acre, drilled at 12 lbs/acre, mulch with a minimum of 3 bales of straw per 1000 square feet. Add 20 lbs/acre of Annual Rye Grass (*Lolium multiflorum*) to the broadcast mix and 15 lbs/acre to the drilled mix. This mix is for use in open areas that receive good sunlight.

- 31% Deertongue (*Dichanthelium clandestinum*), 25% Virginia wild rye (*Elymus virginicus*), 25% Nodding Wild Rye (*Elymus canadensis*), 10% Big Bluestem (*Andropogon gerardii*), and 9% Side-Oats Grama (*Bouteloua curtipendula*), broadcast @ 30 lbs/acre, drilled at 20 lbs/acre), mulch with a minimum of 3 bales of straw per 1000 square feet. Add 20 lbs/acre of Annual Rye Grass (*Lolium multiflorum*) to the broadcast mix and 15 lbs/acre to the drilled mix. This mix is for use in shaded areas, partial sun, and openings in the forest canopy.

Areas that are maintained with regular mowing during the growing season and receive heavy foot traffic will be seeded with an appropriate turf grass mix. Such areas include lawns in cantonment areas, parade fields, and range operational control areas (ROCAs). Turf grass mixes of Kentucky blue grass, fine fescue, and perennial ryegrass using varieties appropriate for the specific application will be identified by the contractor and reviewed and approved by the OHARNG prior to application.

Contractors will provide draught resistant varieties in seed mixes. A potential mix and varieties are as follows.

- 40% Kentucky Bluegrass (applicable varieties), 30% Perennial Ryegrasses (applicable varieties), 20% Hard Fescue (applicable varieties), and 10% Creeping Red Fescue (applicable varieties)

3.3. For projects that disturb one (1) or more acres of ground (or otherwise meet the Ohio EPA criteria for permit coverage), the contractor is required to have a Storm Water Pollution Prevention Plan (SWP3) and should be included in the Work Plan. The Contractor is responsible for the development of Erosion and Storm Water Control (E&S) Plans and Details and the subsequent development of a Storm Water Pollution Prevention Plan (SWP3) in accordance with the requirements contained in the Ohio EPA General NPDES Permit for Storm Water Discharges Associated with Construction Activity. The Contractor will ensure that E&S controls and permanent post construction / water quality controls comply with Section 438 of the Energy Independence and Security Act of 2007 (EISA) and the latest version of the Ohio Department of Natural Resources publication titled **"Rainwater and Land Development - Ohio's Standards for Storm Water Management and Land Development and Urban Stream Protection" (available on-line)**.Most CERCLA projects do not require coverage under a applicable stormwater permit but all substantive requirements of the Ohio EPA General Permit for Construction Activities must be followed.

3.4. The Contractor will implement the SWP3 and conduct all inspections and maintain storm water/erosion controls in accordance with the SWP3 and Ohio EPA requirements. The Contractor will use the inspection checklist for storm water controls in the SWP3 or the Ohio EPA inspection checklist from the General Permit and will complete and maintain signed inspections on site in the SWP3 binder. Copies of weekly/post storm event inspections will be provided to the OHARNG project manager and Environmental Office monthly. The Contractor will notify the OHARNG project manager and Environmental Office immediately if there is a storm water control failure and off site discharge from the project area. Any proposed changes to the SWP3 must be coordinated with and approved by the OHARNG. The person conducting the stormwater inspections must be competent and well versed and have experience in stormwater management and inspections and proof of experience must be provided in the SWP3. The Contractor must keep a corrective action log during the project and document all deficiencies and corrective actions.

3.5. The Contractor will use best management practices or whatever means necessary to prevent contamination of storm water due to runoff from wastes, debris piles, fuel tanks, materials, equipment, and other storage/materials on the project site.

3.6. The Contractor is not permitted to disturb or fill any wetlands, streams, or other surface waters while performing tasks within the scope of work unless such disturbance or fill is specifically identified as a task in the scope and applicable permits and authorizations have been obtained. The Contractor will maintain a 30 foot undisturbed buffer around wetlands and depressional areas that hold water and will keep all equipment, materials, vehicles, debris, waste, and personnel out of this buffer and prevent discharges of any type (chemical or soil) from entering such areas.

3.7. The OHARNG Environmental Office must approve all dewatering activities. Dewatering will be addressed in the waste management section or dewatering section of the Work Plan if applicable to the project. Standing water must be characterized to determine if it is regulated before dewatering procedures are implemented. Characterization may be possible by generator knowledge or may require sampling and analysis. At minimum, discharges must meet water quality standards identified in Ohio Administrative Code 3745-1 and Ohio EPA requirements. If able to be discharged, at minimum, water must go through an oil absorption and/or an activated charcoal, and/or a sediment filter bag as appropriate, prior to being discharged. Discharge will be done in a vegetated upland area that drains away from the work site unless otherwise specified in the scope of work or authorized by the OHARNG Environmental Office. Discharge will be done so as to allow the discharge to filter through dense groundcover vegetation. The discharge hose will be set on a piece of plywood or rubber mat to disperse the water and prevent a concentrated discharge that can cut and erode soil. Direct discharge to a stream, pond, wetland, ditch or other body of water or conveyance is not permitted. If water does not meet state standards or approval for discharge, then it must be properly transported and disposed.

4. Waste, Recycling and Hazardous Waste

4.1. The OHARNG is the generator of all waste including wastes generated by any Contractor working on OHARNG projects of facilities. The Contractor is responsible for minimizing all waste generation from OHARNG projects and for properly managing all wastes generated from OHARNG projects in accordance with the Ohio Army National Guard Waste Management Guidelines (attached). Waste will be managed in accordance with all applicable Federal, State, U.S. Army, NGB and OHARNG regulations and requirements. OHARNG sites may have specific hazardous waste information / management guidelines that must be followed to ensure compliance with applicable regulations and requirements. The contractor must include all waste management in their Work Plan and coordinate all waste generation and management activities with the OHARNG Environmental Office prior to beginning work.

4.2. The Contractor is responsible for characterizing all waste generated from a project and notifying the OHARNG of all waste streams, management methodology, and disposal methods prior to beginning work. If an alternative practice is available that will eliminate, recycle or minimize waste generation, the contractor is required to implement such practice.

4.3. The Contractor is responsible for properly labeling, storing, and inspecting non-hazardous, special, and hazardous waste stored at the project site pending disposal. All containers on the project site will be labeled as to the contents, whether waste or otherwise. All waste stored on site must be inspected weekly using the Ohio Army National Guard Weekly Non-Hazardous and Hazardous Waste Inspection/Inventory Sheet (attached).

4.4. The Contractor is responsible for properly completing all waste profiles, waste manifests, and shipping documents (hazardous, special and non-hazardous waste). Such documents will be reviewed, approved, and signed by the OHARNG Environmental Office. No waste will leave the site until the shipping documents are reviewed, approved and signed by the OHARNG Environmental Office. The Contractor is responsible for weighing and documenting all waste material (regulated, diverted, landfilled) leaving the site. The Contractor will complete a Construction/Demolition Diversion and Waste Disposal Form (attached) or other waste tracker and provide supporting documentation (weight tickets, manifests etc.) to the OHARNG at the end of the project. Contractors may be asked to provide monthly waste totals for waste total reporting and for monthly Ohio EPA update reports.

4.5. The Contractor is required to recycle materials when possible and practicable. Recycled materials must be tracked using the Construction/Demolition Diversion and Waste Disposal Form (attached). Materials that cannot be recycled or repurposed must be properly disposed at an appropriate waste handling facility.

4.6. The Contractor is required to utilize qualified Defense Logistics Agency (DLA), Defense Marketing and Reutilization Organization (DRMO) waste haulers and Treatment, Storage, and Disposal Facilities (TSDFs) for hazardous waste. The current qualified waste hauler and TSDF list can be viewed by following the “Qualified Facilities” and “Qualified Transporters” links found on the DLA Disposition Services’ Hazardous Waste Disposal Homepage, http://www.dla.mil/DispositionServices/Offers/Disposal/HazardousWaste/HazWasteDisposal.aspx.

4.7. Gray water, vehicle wash water, and other liquid wastes (to include extracted groundwater and water from dewatering) generated by the Contractor will be managed in accordance with the waste management guidance in this section and applicable federal, state, and local regulations. Liquid waste will not be discharged to the land surface, surface water, storm drain/ditch, or a sanitary sewer unless properly characterized and done in accordance with applicable laws and applicable permit conditions. Liquid waste will be characterized and proper management and disposal methods identified and implemented. Guidance on construction site dewatering is provided above.

5. Asbestos

5.1. All asbestos activities, including any disturbance or removal, must be conducted in accordance with applicable Federal, State, and local regulations. Asbestos must be properly handled, removed, containerized, and disposed of in accordance with applicable Federal, State, and local regulations. The Contractor will complete a Construction/Demolition Diversion and Waste Disposal Form (attached) and provide supporting documentation (weight tickets, manifests etc.) for all wastes generated to the OHARNG at the end of the project. Asbestos removal methods and disposal operations will be detailed in the Work Plan to be reviewed and approved by the OHARNG Environmental Office prior to the start of work activities. All abatement activities will be conducted by a licensed abatement contractor in accordance with applicable Federal, State, and local regulations and guidance. All asbestos wastes generated as part of demolition activities and/or abatement activities must be disposed of in a licensed asbestos landfill. Disposal manifests and/or Regulated Asbestos Material Waste Shipment Records for all asbestos waste must also be signed and approved by an OHARNG Environmental Office representative or a representative designated by the Environmental Office prior to shipment from the project site or OHARNG facility.

5.2. As required for asbestos projects, the Contractor is required to submit a completed Ohio Environmental Protection Agency (EPA) Notification of Demolition and Renovation Form to the OHARNG for review and approval 30 days prior to commencement of asbestos work. Upon receipt of written approval from the OHARNG Environmental Office, the approved notification and associated notification fee must be submitted to the Ohio EPA at least 10 business days prior to commencement of work. Under no circumstances is the Contractor to submit any correspondence to the Ohio EPA or any other regulatory agency without written approval from the OHARNG. Copies of all correspondence from the Ohio EPA or any other regulatory agency must be submitted to the OHARNG Environmental Office upon receipt. If requested, the Contractor must provide a copy of the asbestos survey to the regulatory agency.

5.3. The Contractor is required to develop and submit a Work Plan that includes asbestos abatement to the OHARNG for review and approval prior to the commencement of work. The work plan will specify the procedures to be utilized by the contractor to ensure compliance with all applicable State and Federal asbestos regulations. The work plan will address the abatement techniques to be used, the safety precautions to be taken, and emergency procedures to be implemented in the event of inadvertent exposure. Proof/copies of proper and current contractor licensure must also be included in the work plan. The work plan will also address how the asbestos waste is to be handled, stored, transported, and disposed of in accordance with all applicable regulations. Site clearance procedures must be addressed in the plan if applicable. The plan must contain a detailed description of the project activities, including the amount of asbestos to be abated, the exact location and type of asbestos, and whether or not a contained work site will be established as required by 29 CFR Part 1926.1101.

5.4. Asbestos contractors must be properly licensed in accordance with applicable local, State, and Federal regulations. Only licensed contractors approved and licensed through the Ohio EPA will be utilized on OHARNG asbestos abatement projects. The contractor will show proof of license and will maintain appropriate paperwork on the work site at all times. Work is to be performed in accordance with 29 CFR 1926.1101 (OSHA Asbestos Construction Standard) and 40 CFR Part 61 (Asbestos NESHAPS) in addition to accepted industry work procedures and other applicable local, State, and

Federal regulations. The onsite Superintendent must be a ‘competent person’ as defined in 29 CFR 1926.1101(b) and must be onsite full time during the project.

5.5. The Contractor is responsible for managing all asbestos waste generated during the project. Any asbestos removed must be properly abated, containerized, managed, labeled and disposed of as an asbestos waste in accordance with applicable local, State, and Federal regulations. Asbestos waste must be properly transported to an approved, licensed asbestos disposal facility. Waste shipment records must be maintained during transport. A final copy of the waste shipment record will be forwarded to the OHARNG within 30 days for recordkeeping. A representative from the OHARNG Environmental Office will review and sign all waste profiles and manifests generated as the result of any asbestos abatement activities prior to the shipment of the waste from an OHARNG facility to a disposal facility.

6. Earth Fill

6.1. Any earth fill brought on site must be free of chemical contaminants and organic material (plant or animal parts). The contractor will identify the source of earth fill in the Work Plan.

6.2. Fill material must be sampled prior to coming onsite. One sample will be collected using incremental sampling methodology (ISM) or composite sampling for every 4,000 cubic yards of earth fill. This quantity of earth fill must come from the same source or an additional sample must be collected. The samples will be analyzed for the following parameters: VOCs (total compound list), SVOCs (total compound list), pesticides (total compound list), PCBs, Explosives, Nitro-glycerine, Nitro-guanadine, Nitrocellulose, TAL Metals, pH. The results will be screened by the contractor against a provided list of facility background levels. The earth fill must be approved by the OHARNG and, at a minimum, be at or below the facility-wide background values.

7. Natural Resources

7.1. Threatened and Endangered Species

The OHARNG has training areas and facilities throughout the State of Ohio. Both federally and state listed rare species have been identified at a few OHARNG locations and all OHARNG locations are within the known ranges of other listed species. The OHARNG is required to protect listed species. In addition, there are migratory birds that nest in vegetation and structures on OHARNG property. The Migratory Bird Treaty Act prohibits harm to nesting migratory birds, their eggs, and their nests (with the exception of a few introduced species). The Contractor is responsible for doing everything possible so as to not intentionally or unintentionally harm any listed or protected species at any OHARNG facility. Immediately prior to the action commencing, the contractor will perform a thorough inspection for nesting birds, inhabiting bats, or other animals within the project area (structure(s), construction site, etc.). This thorough search will be to determine if any bats, birds, or other animals are present within the work area (under roof flashing, under siding, nesting in brush, etc.). The Contractor will also remain alert for the presence of any animals during project implementation. This is particularly important for demolition because animals may be utilizing old/abandoned buildings or structures. If any animals are found, the contractor will stop work in that area and immediately notify the project manager and the OHARNG Environmental Office.

The OHARNG can impose project specific restrictions on activities due to regulatory requirements. Any such project specific restriction will be identified in the project scope of work and/or contract language and discussed with the contractor prior to bidding and commencement of work. The Contractor is required to comply with any such restrictions.

7.2. Mowing

There are no seasonal mowing restrictions on maintained lawns, grassland rights-of- way, and easements that are regularly mowed and maintained at a height of less than 10 inches. Grass and brush that is allowed to grow more than 10 inches tall during bird nesting season becomes suitable habitat for grassland nesting birds and will not be mowed between 15 April and 15 August unless the Contractor has confirmed the absence of nests and nesting birds to the satisfaction of the OHARNG Environmental Office**.**

7.3. Vegetation Clearing and Tree Trimming

The Contractor must inform the OHARNG Environmental Office of their intended schedule a minimum of two weeks in advance of a vegetation clearing, tree cutting/felling, or tree trimming project. The OHARNG will determine if the proposed work dates are within the allowable window for the location and type of work being conducted. If work is proposed within the restricted time period, the Contractor will have to reschedule the work.

Tree and vegetation clearing, brush cutting, tree felling/cutting (height equal to or greater than 24" above ground) and tree trimming of any branches and any other part of the tree that is at least three inches in diameter, can only occur between 1 October and 31 March. Abandoned wood utility poles are treated as trees in the sense that they can only be felled between 1 October and 31 March.

When clearing trees the contract specification will identify if the trees must be removed and hauled off site by the contractor or if they will remain on site to be salvaged by the government. The government will salvage trees when they are determined by the OHARNG Forester to have adequate commercial value as sawtimber or another forest product. When trees remain on site the Contractor will transport them and neatly stack them in a location designated by the OHARNG. If taken offsite, the Contractor will recycle the material as firewood, biomass, mulch, fuel chips, or some other reuse.

When trees are salvaged as sawtimber, all 8' 6" and longer straight portions of the trees up to a 10" diameter outside bark top that are felled will be limbed and neatly stacked in a location designated by the OHARNG. Limbing will consist of cutting limbs flush to the boll of the trees. Branch stubs are not permitted. Trees will be kept and stacked in as long of lengths as possible and under no circumstance less than 8'6" long. Pieces shorter than 8'6" are not suitable for sawtimber salvage. The Contractor will not cut otherwise longer tree sections to a length less than 8' 6" to avoid managing them a as sawtimber.

When trees are salvaged for firewood and/or biomass, all portions of the trees down to a 4" diameter top will be cut into 4.5' to 9' lengths and neatly stacked in an area designated by the OHARNG. Firewood salvage will include sawtimber sized trees that have poor form or are too short to be sawtimber and sawtimber topwood.

Limbs, branches, brush and tree parts not salvaged will be removed from the site and recycled. This material will be chipped prior to removal. If only a small amount of chips are generated and the work is not within a cantonment or other maintained area, the chips will be blown/scattered in adjacent unimproved areas/woodlands. Piles of chips are not permitted and chips will not be placed in wetlands. Brush can be ground or chipped in place as part of the clearing operation.

7.4. Stumps

Stumps will be ground or excavated in accordance with contract specification requirements. Stumps that are two feet tall or taller will not be ground or removed between 1 April and 30 September. Grinding of all stumps (to include major roots) will be to a minimum depth of 6 inches below ground surface. Grindings will be managed as directed by the project specifications. If in an upland area, chips can be spread on site adjacent to the stump. Grindings will not be spread in wetlands. If the area is not being leveled and re-graded, stump holes must be leveled and filled with clean fill dirt and top soil. Piles of grinding and chips will not be left on the project area or anywhere in a mowing zone.

The Contractor will not place chips or any parts of trees, brush, or any type of fill into any wetland including but not limited to ditches, streams, floodplain areas, wet spots or low areas. Stumps in wetlands will not be ground or excavated without a wetland permit and prior approval of the OHARNG Environmental Office.

If stumps are excavated, the contractor is required to remove and properly dispose of the stumps offsite or as otherwise specified within the project specifications. Surface disposal or burial on OHARNG property is not permitted.

7.5. Vegetation Establishment

The Contractor is responsible for ensuring the establishment of vegetative cover and soil stabilization of the project area and must use all means available and necessary to accomplish this. Straw erosion mats, rip rap, geo-cell, or other applicable soil stabilization methods, when needed, will be proposed to the OHARNG and approved before implementation. The contractor will utilize native vegetation. Vegetation to be used on a project will be identified in the Work Plan.

The Contractor is required to prepare an adequate seed bed prior to seeding. The seed bed must consist of clean, weed free top soil and must be broken up and loose and suitable for seed germination. Fertilization will be required if the soil is poor and/or nutrient levels are low. Lime will be applied as necessary to adjust the soil pH to the recommended level for the seed being sown.

An appropriate turf grass mix will be used for high traffic and high maintenance areas. Annual ryegrass can be added to mixes to provide quick cover. For late season seeding, winter wheat/rye can be added to provide a quick cover. Contractors will use approved grass seed mixes provided by the OHARNG. The OHARNG Environmental Office must approve all seed mixes. Seeding must be mulched with at least 2 inches of straw mulch if broadcast seeded, an appropriate fiber matting, or an appropriate cover if hydro-seeded. Seed drilling usually does not require mulch.

8. Cultural Resources

If during a project, the Contractor makes an inadvertent discovery of human remains, funerary items, animal remains, household artifacts or other artifacts, they will immediately stop work. All remains and artifacts will be left in place and measures taken to protect the site and artifacts from pilferage and damage will be implemented. The project manager, contracting office, and OHARNG Cultural Resources Manager will be notified immediately. In the event that human remains are identified, the on-site OHARNG security personnel or Range Control must be immediately contacted to allow them to contact the appropriate law enforcement agency.

9. Unanticipated Munitions Discovery

If unanticipated munitions, MEC, or MD are encountered at a work site, ground disturbing work will stop immediately, personnel will vacate the area, the area will be secured to keep personnel out, and the Contractor will immediately notify the USACE Project Manager and OHARNG Range Control. The OHARNG will investigate the discovery and coordinate with the appropriate UXO or Explosive Ordinance Division (EOD) support personnel. Contractor work in the area of the munitions will be suspended until the area is made/ declared safe by a qualified munitions/EOD technician. If the discovery of munitions results in the need to change the scope of work and/or contract terms, such changes will be determined by the Army team. Should the overall project require munitions investigation or removal or UXO construction support, details will be provided in the project-specific SOW or PWS.

10. Other

Keys shall be obtained and signed out from the OHANRG environmental office or CJAG logistics. Keys shall be returned after each field activity to the appropriate location. Keys shall not be copied or destroyed.

Positive drainage and grading shall be established and conducted by the Contractor in all disturbed project areas. This includes remediation areas, ruts, access/haul routes, laydown areas etc. Areas must be returned to conditions prior to disturbance. OHARNG/ARNG will approve final conditions.

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D.2 – FIRST RESPONDER FORM (SPILL RESPONSE)

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QRG 2.2 FIRST RESPONDER REPORTING FORM

Collect as much of the information on the top half of this form as possible before making initial notification. Complete the top and bottom of the form before turning in to Range Operations.

Name of individual reporting spill: ____

When did the spill occur (Date and Time)? ____

Spill Location (Building or area name / number, indoors or out; if vehicle involved, type and bumper number):
____

What was spilled? ____________________________________ **How much was spilled?** __________________________________

Rate at which material is currently spilling. ____

Extent of spill travel? ____

Did the spill reach water (ditch, creek, stream, pond, well head)? ____

Number of injured personnel and type injuries, if applicable. ____

Do you need the Fire Department to respond to protect life, property, and environment? __________________________________

Unit: _____________________________________ **State:** ____________ **Report Date & Time:** __________________________

On Scene Coordinator Name and Grade: ____ **Phone:** _______________________

How did the spill occur (be specific)? ____

____

What remedial action was taken? ____

____

Was soil and absorbent material generated? ___________ **How much?** ____

What is the location of the soil and absorbents? ____

Was the Environmental Office contacted (yes or No, date and time)? ____

Who did you talk to in the Environmental Office? ____

Was the site cleared by the Env. Office (Yes or No, date and time)? ____

Who cleared the site (name and grade, date and time)? ____

Initial information is critical. Get as much information as you can, but don't hesitate to make the initial notification if a spill is moving or worsening rapidly!

This form must be completed for all releases and turned-in to CJAG Range Operations within 24 hours.

FIRST RESPONDER SPILL/RELEASE RESPONSE ACTIONS

Units or contractors performing training or other operations at Camp James A. Garfield shall be responsible for adhering to the provisions identified in the Integrated Environmental Contingency Plans (IECP). A copy of the IECP may be obtained from the Camp James A. Garfield Environmental Supervisor. Following discovery of a spill (any size), the procedures outlined below shall be executed where applicable:

1. **If necessary, initiate evacuation of the immediate area.**
2. **Notify Camp James A. Garfield Range Operations via two-way radio or by calling (614) 336-6041, and report information contained on the "First Responder Reporting Form" if it is known or can reasonably be determined. This form has been copied on the opposite side of this page. If Range Operations cannot be reached, contact a Camp James A. Garfield OSC (listed below).**
3. **Stop spill flow when possible without undue risk of personal injury.**
4. **If trained, contain the spill using available spill response equipment or techniques.**
5. **Make spill scene OFF LIMITS to unauthorized personnel.**
6. **Restrict all sources of ignition when flammable substances are involved.**
7. **Report to the OSC upon his/her arrival to the scene. Turn in a completed copy of the Camp James A. Garfield First Responder Form to Range Operations for ALL releases, even ones cleaned up by the reporter.**

TELEPHONE NUMBER

When Camp James A. Garfield Range Operations is *not available*, the OSC *must be contacted* by the discoverer/first responder following a release if it is in water, at or above a reportable quantity (25 gallons or more of POL), a hazardous or extremely hazardous substance, a hazardous waste, or involves fire, explosion, or is otherwise a major incident.

NAME	JOB TITLE	OFFICE	24 HOUR
Camp James A Garfield Range Operations	Operations and Training	(614)336-6041	(614) 202-5783
Tim Morgan (Primary OSC)	Environmental Supervisor	(614)336-6568	(330)322-7098
Brad Kline (Alternate OSC)	Environmental Specialist	(614)336-4918	Contact Alternate
Katie Tait (Alternate OSC)	Environmental Specialist	(614)336-6136	Contact Alternate
Joint Forces Command (Alternate POC)	OHARNG Emergency Center	(888)637-9053	(888)637-9053

Off-site (from Camp James A. Garfield area code 614 phones)

Ravenna Dispatch 9-1-330 296-6486

SEE REVERSE FOR FIRST RESPONDER REPORTING FORM

D.3 – OHARNG INADVERTENT DISCOVERY PROCEDURES

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STANDARD OPERATING PROCEDURES NO. 5A
OHARNG Procedures for Inadvertent Discovery of Cultural Materials at Camp Ravenna Joint Military Training Center
(taken from OHARNG ICRMP and modified for CRJMTC)

Contact(s): Kim Ludt, OHARNG Cultural Resources Manager, 614-336-6569
(Alternate contact, CRJMTC Environmental Office, 614-336-6568/6136)
CRJMTC Range Control 614-336-6041 or MARCS radio Channel #1

Scope: This Standard Operating Procedure (SOP) outlines the steps to be taken upon inadvertent discovery of human remains or artifacts at Camp Ravenna Joint Military Training Center (CRJMTC) during construction, demolition, training events, or other ground disturbing activities. If archaeological surveys or excavations become necessary as a result of the inadvertent discovery, they must be conducted by a person meeting the Secretary of Interior's professional qualification standards for archaeology. Anyone who does not meet these standards and engages in any excavations, including probing during metal detecting, shall be considered to be looting the cultural resources of CRJMTC and subject to prosecution under ARPA. This SOP is intended for all OHARNG personnel, contractors and users of CRJMTC.

Statutory Reference(s):

- Native American Graves Protection and Repatriation Act (NAGPRA) and its implementing regulation (43 CFR 10)
- Archaeological Resources Protection Act (ARPA)
- National Historic Preservation Act (NHPA) and its implementing regulation (36 CFR 800).

Procedures: In the event that artifacts or human remains are encountered, the ground disturbing activity should stop immediately and the following steps should be followed.

- Report any observations or discoveries of artifacts or human remains immediately to CRJMTC Range Control (614-336-6041 or MARCS radio Channel #1). Range Control will immediately notify the OHARNG Cultural Resources Manager (CRM)/CRJMTC Environmental Office.
- The Range Control or the CRM will secure any artifacts or human remains, as appropriate. If human remains are suspected, they are not to be disturbed and Range Control will promptly notify Ohio State Highway Patrol or Federal Bureau of Investigation, as appropriate.
- The CRM and Range Control will take measures to protect the location from further disturbance until appropriate parties are notified.
- If a concentration of artifacts or a burial site is identified as the source of materials discovered, the CRM will make arrangements for site recordation and stabilization, in consultation with the OHPO and any interested Native American tribes.
- Once the site has been cleared by the CRM and CRJMTC Range Control, the activity may resume. Depending on the findings, activities may be cleared to resume in 48 hours or up to 6 months.

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APPENDIX E

PROJECT PLANNING SESSION PRESENTATION AND MEETING MINUTES

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Project Planning Session
Former Ravenna Army Ammunition Plant
Meeting Minutes (Revision 1)

Teleconference Information

DATE: July 18, 2023 (Tuesday)
TIME: 12:30-2:00 p.m. EST
CONFERENCE CALL-IN INFORMATION: (855) 534-3677 Conference ID: 822476524
Microsoft Teams: https://gov.teams.microsoft.us/l/meetup-join/19%3agcch%3ameeting_cda85b1ea1d341708ecc6d0bdfcc2f13%40thread.v2/0?context=%7b%22Tid%22%3a%22b64da4ac-e800-4cfc-8931-e607f720a1b8%22%2c%22Oid%22%3a%220ba6af77-6847-4d7d-a264-ea9e7b8ae673%22%7d

Presentation

Leidos Presentation: Project Planning Session For Investigations at the Former Ravenna Army Ammunition Plant, July 18, 2023
Handouts:

1) RVAAP_Project Planning Session_0782023_FINAL (MS PowerPoint presentation)
2) Figures that are in the presentation

Attendees

U.S. Army Corps of Engineers: Steve Kvaal
OHARNG: Katie Tait
Ohio Environmental Protection Agency: Megan Oravec, Kevin Palombo, Nick Roope, Ed D'Amato
Leidos: Jed Thomas, Mike Barta, Ryan Laurich, Sarah Kosbab

Scope of Meeting

Discuss sampling strategy presented in the following UFP-QAPPs:

- RVAAP-34 Sand Creek Disposal Road Landfill – Additional Delineation Sampling
- CC RVAAP-69 Building 1048 Fire Station – Vapor Intrusion Study for Building 1037
- CC RVAAP-78 Quarry Pond Surface Dump – Remedial Investigation of Asbestos
- Multiple Areas of Concern - Additional Remedial Design Sampling
    - RVAAP-38 NACA Test Area,
    - RVAAP-42 Load Line 9,
    - RVAAP-45 Wet Storage Area,
    - CC RVAAP-76 Depot Area

Meeting Minutes

The following minutes supplement the presentation referenced above. If notes are not provided for a slide, no additional dialogue occurred beyond what is presented in the slide.

Slide 1: Title Slide

- Jed Thomas initiates the meeting.
- All attendees are introduced.

Project Planning Session
Former Ravenna Army Ammunition Plant
Meeting Minutes (Revision 1)

Slide 2: Purpose of Project Planning Session

- Jed indicates that the Project Planning Session is done, in part, to define the purpose and expected results of the project and the final products and deliverables for the project. Worksheet 9 of the UFP-QAPP documents the Project Planning Session(s).
- Jed comments that the UFP-QAPPs have been submitted as Preliminary Draft stage and are undergoing Army review.
- Jed clarified that the scope of this contract is to perform sampling and investigation. The contract does not include removal or remedial actions.

Slide 3: Project Team

- Megan Oravec states that currently Ed D'Amato is the Ohio EPA Site Coordinator for CC-RVAAP-69 Building 1048 Fire Station, CC-RVAAP-78 Quarry Pond Surface Dump, and the Multiple Areas of Concern investigation. The Ohio EPA Site Coordinator(s) for the other sites are not yet determined.

Slides 4-8: RVAAP-34 Sand Creek Disposal Road Landfill Additional Delineation Sampling

- Katie Tait notes that there are plans to demolish the nearby buildings.
- Ed asks what sampling was used to determine the extent for the removal action.
    - Jed responded that the removal areas were the extent of the ISM areas sampled during previous investigations. Discrete and ISM samples were collected as confirmation samples during and after the removal action. Discrete samples are planned for the investigations presented in this Project Planning Session.
- Jed summarizes the icons associated with the figure on Slide 7 (and subsequent figures).
    - Red triangles are locations that exceeded CUGs, and green triangles are locations that did not exceed CUGs.
    - If the excavation floor sample results were below the CUG, no more floor samples were taken.
    - If the excavation wall samples were below the CUG, then there was no step-out sampling.
    - The squares represent proposed step-out soil sample locations.
- Kevin asked if the proposed samples will be the basis for removal.
    - Jed responded by saying the removal will go up to locations where samples are below the CUG.
- Nick Roope asked how frequent the bank of Sand Creek floods.
    - Katie responded that it is not monitored, but it does have frequent high water.
    - Ryan Laurich noted that a monitoring well immediately adjacent to Sand Creek is showing signs of erosion.
    - Katie said that water from Sand Creek did not enter into the excavations during removal action activities.
- Katie mentioned that some restoration actions will be necessary during excavation activities.

Project Planning Session
Former Ravenna Army Ammunition Plant
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Slides 9-15: CC RVAAP-69 Building 1048 Fire Station Vapor Intrusion Study of Building 1037

- Kevin asks if it is correct that the focus will be on the vapor intrusion of Building 1037 and the groundwater sampling.
  - Jed confirmed that is correct.
- Kevin asks if Building 1034 at the Motor Pool is occupied and if there is a concern for vapors.
  - Katie responds that there are maintenance activities being done currently, however eventually all those activities will be moved to a different site. Regarding occupation, no one is there for the full 8 hr day and there are also large garage doors.
- Nick Roope made a comment that risk assessors consider showers a preferential pathway for VI.
  - Katie responded that the shower rooms are used for storage but is unsure about the drains and if they have been plugged or not.
- Ryan commented that Charles Spurr (of Leidos) is familiar with the area and has experience doing VI studies.
- Jed commented that the VI study and groundwater study are treated as separate studies. The next step would be to develop the FS.
- Kevin asked if there was a tank where the groundwater data shows the highest COC concentrations.
  - Katie responded that carbon tetrachloride was stored in the tank near the highest COC concentration in groundwater.

Slides 16-19: CC RVAAP-78 Quarry Pond Surface Dump Remedial Investigation of Asbestos

- Jed notes that the results will be incorporated into an RI Report for asbestos.
- Kevin asked if trenches were 14 ft deep and if there were any other contaminants besides ACM.
  - Jed confirmed that the trenches will be 14 ft deep and that ACM is the only contaminant being assessed in this investigation.
- Katie commented that it's hard to see ACM in soil borings and trenching is a better method to determine extent.
- Mike Barta stated the trenches will get near the road to the west but is not expected to impact the road.

Slide 20: Multiple Areas of Concern

- Kevin points out that there is a typo on Slide 20: "RVAAP-38 NACA Test Area: Area 1, Area 2, and Area 2." The last area should be Area 3.

Slides 21-23: RVAAP-38 NACA Test Area Additional Remedial Design Sampling

- Kevin asks if the plane fuel from crash tests is the source of the COCs.
  - Katie confirms that jet fuel was used but is unsure if that is the sole source of contamination.
  - Jed notes that besides the Well Pit (contaminated with lead), all of the COCs at the site are PAHs.

Project Planning Session
Former Ravenna Army Ammunition Plant
Meeting Minutes (Revision 1)

Slides 24-26: Load Line 9 Additional Remedial Design Sampling

- Regarding the figure:
  - Leidos will change the green icon at LL9cs-144M to red, as the location had an exceedance.
  - Leidos will change the red icon at LL9cs-142M to green, as the location did not have any exceedances.

Slides 27-28: Wet Storage Area Additional Remedial Design Sampling

- Kevin asked why the site is called Wet Storage Area.
  - Katie responds that the area used to store sensitive explosives in water/other solutions in drums.

Slides 29-31: Depot Area Additional Remedial Design Sampling

- Kevin asks about green triangles followed by red triangles on the north side of the figure.
  - Jed confirms that the green triangle is an excavation floor, and the red triangle is a wall.

Slide 32: Questions

- Nick asks if submittals will be staggered.
  - Jed responded that there is not a current plan to stagger submittals. Rather the Draft UFP-QAPPs will be submitted once reviewed by the Army and resolved.

ATTACHMENT A.1

Project Planning Session
For
Investigations at the Former Ravenna Army
Ammunition Plant
July 18, 2023
(Presentation)

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Project Planning Session For Investigations at the Former Ravenna Army Ammunition Plant

Presented by:
Leidos

July 18, 2023

US Army Corps of Engineers®

www.rvaap.org

Purpose of Project Planning Session

- **Present the Project Team**
- **Discuss sampling strategy presented in UFP-QAPPs:**
  - RVAAP-34 Sand Creek Disposal Road Landfill – Additional Delineation Sampling
  - CC RVAAP-69 Building 1048 Fire Station – Vapor Intrusion Study for Building 1037
  - CC RVAAP-78 Quarry Pond Surface Dump - Remedial Investigation of Asbestos
  - Multiple Areas of Concern - Additional Remedial Design Sampling
    - RVAAP-38 NACA Test Area,
    - RVAAP-42 Load Line 9,
    - RVAAP-45 Wet Storage Area,
    - CC RVAAP-76 Depot Area

Project Team

- **Army National Guard (lead agency)**
- **Ohio Army National Guard**
- **U.S. Army Corps of Engineers**
- **Ohio Environmental Protection Agency**
- **Leidos (performing contractor)**

RVAAP-34

Sand Creek Disposal Road Landfill Additional Delineation Sampling

- **Driver of additional sampling?**
  - Confirmation sampling completed under the *Remedial Action Completion Report for Soil, Sediment, and Surface Water at Multiple Areas of Concern* (Alaniz-Endpoint 2022) determined that project Cleanup Goals (CUGs) for soil were not achieved at four excavations.
    - ➢ SCsb-037M, SCsb-049M, SCss-060M, and SCss-062M
- **Goal of delineation sampling**
  - Prepare an RI Addendum that presents the results of the delineation sampling and recommend extents of soil removal to achieve the goals of the remedial action.

RVAAP-34

Sand Creek Disposal Road Landfill Additional Delineation Sampling

- **Project Cleanup Goals (CUGs)**

Excavation Area	COC	Cleanup Goal (mg/kg)
SCsb-037M	Arsenic	20.1
SCsb-049M	Benzo(a)pyrene	1.1
SCss-060M	Benzo(a)pyrene	1.1
SCss-062M	Arsenic	20.1

- **Exceedances**
  - SCsb-037M: arsenic – north, east, south, and west sidewalls of excavation, and floor of excavation.
  - SCsb-049M: benzo(a)pyrene – east and south sidewalls of excavation.
  - SCss-060M: benzo(a)pyrene – northwest and southeast sidewalls of excavation.
  - SCss-062M: arsenic - northwest, southwest, northeast, and southeast sidewalls, and floor of excavation.

RVAAP-34

Sand Creek Disposal Road Landfill Additional Delineation Sampling

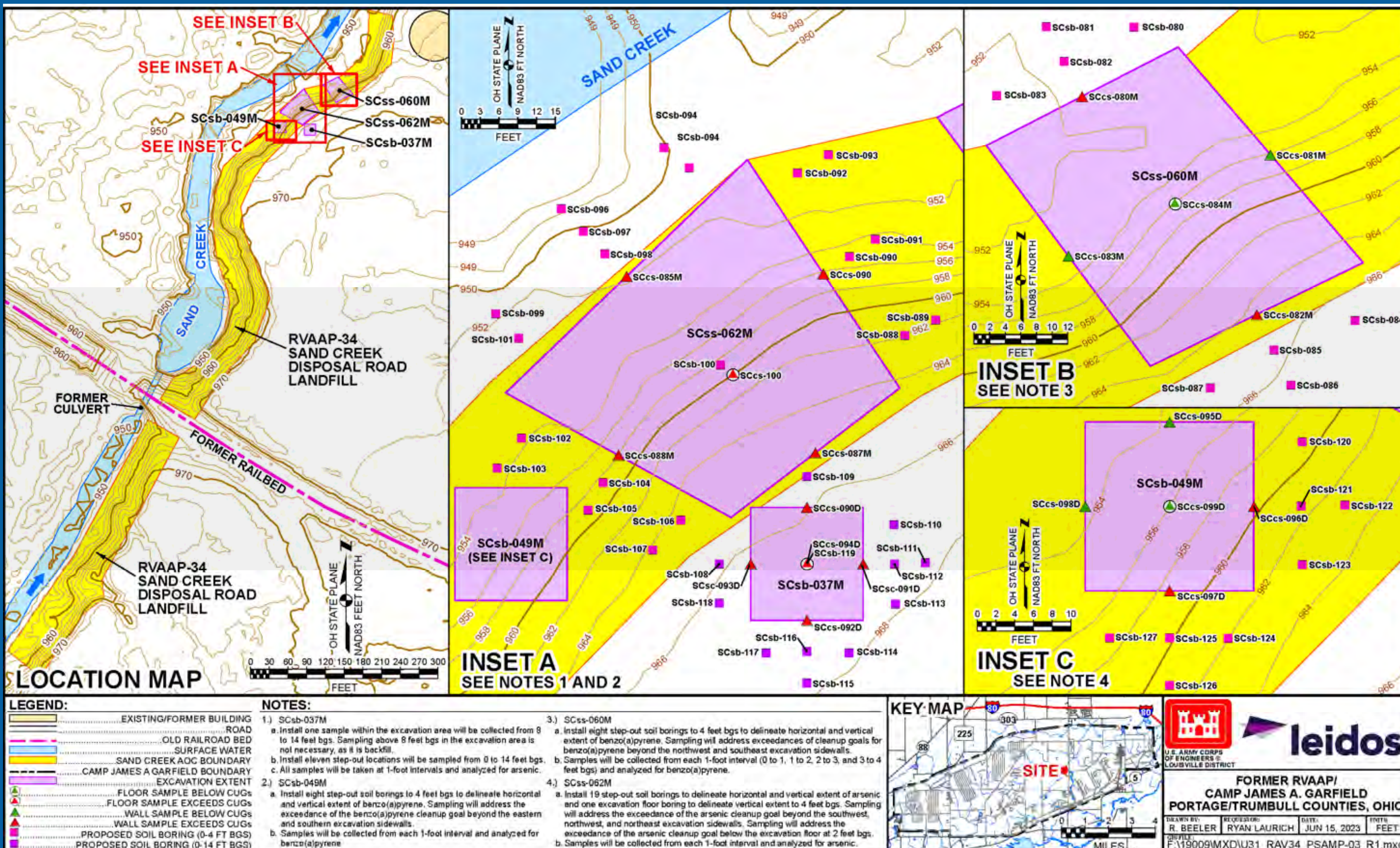
- **Proposed Delineation Sampling Breakdown**

Excavation Area	Soil Borings	Soil Samples	
		Surface	Subsurface
SCsb-037M	12	11	149
SCsb-049M	8	8	24
SCss-060M	8	8	24
SCss-062M	20	20	60

- **Soil Samples**
  - Surface: 0-1 ft bgs (SCsb-037 only at step-out locations)
  - Subsurface: 1 ft intervals
    - SCsb-037M: to a depth of 14 ft bgs (step-out begin at 1 ft bgs, within excavation area begin at 8 ft bgs).
    - SCsb-049M, SCss-060M, and SCss-062M: 1 ft intervals down to 4 ft bgs.
- **Analytes**
  - SCsb-037M: arsenic
  - SCsb-049M: benzo(a)pyrene
  - SCss-060M: benzo(a)pyrene
  - SCss-062M: arsenic

RVAAP-34

Sand Creek Disposal Road Landfill
Additional Delineation Sampling



Questions?

CC RVAAP-69
Building 1048 Fire Station
Vapor Intrusion Study of Building 1037

- **Driver of additional sampling?**
  - Multiple VOCs have been detected in environmental media (i.e., soil and groundwater) at the CC RVAAP-69 Building 1048 Fire Station AOC, which is immediately upgradient of Building 1037. VOCs may pose unacceptable risk for vapor intrusion.
  - Soil vapor sampling has not been completed at Building 1037.
  - Additional groundwater sampling as due diligence to determine the presence of groundwater concentrations exceeding Vapor Intrusion Screening Levels that would cause a concern for potential VOC vapors
- **Goal of VI Study at Building 1037 and groundwater sampling at existing wells at Building 1048 and Building 1034 (Motor Pool Hydraulic Lift).**
  - Provide supplemental data to support the Feasibility Study.
  - Determine if vapors are posing an unacceptable risk to human health for occupants at Building 1037.

CC RVAAP-69

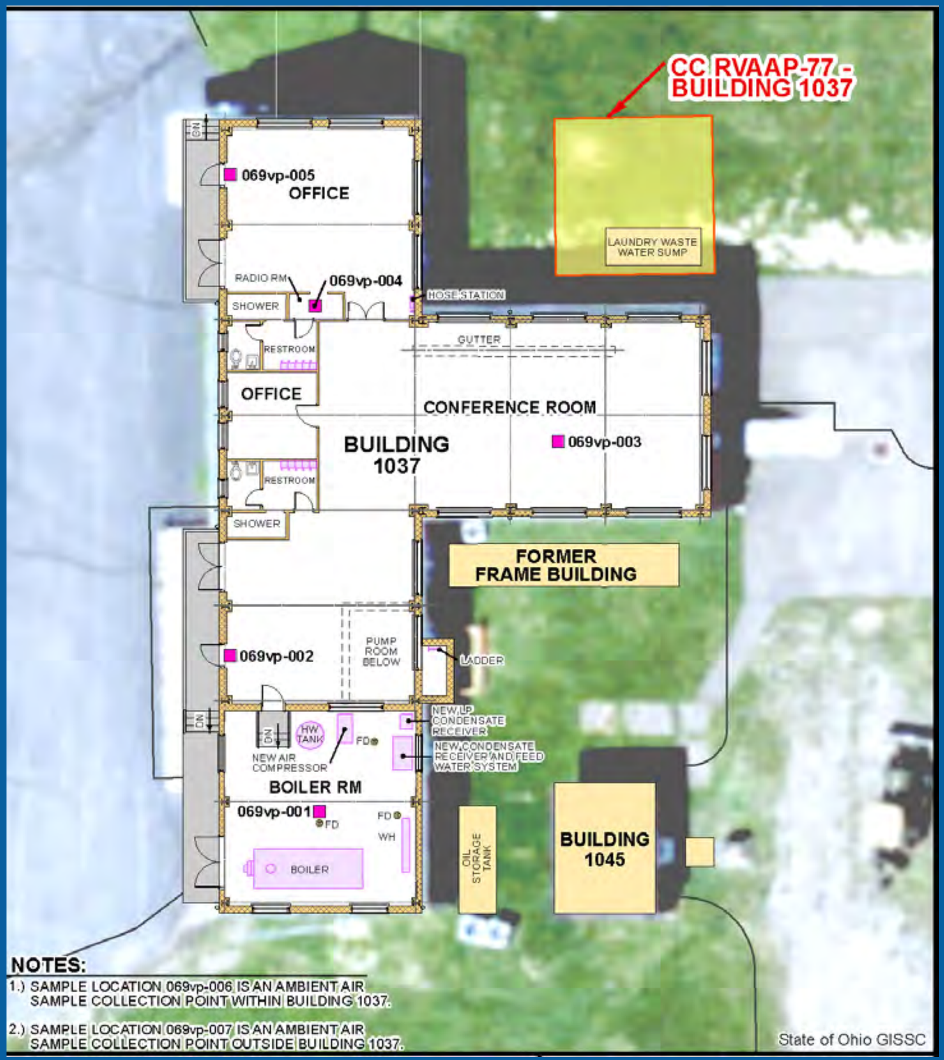
Building 1048 Fire Station
Vapor Intrusion Study of Building 1037

- **Vapor Intrusion Sampling**
  - 5 Sub-slab Soil Vapor Sampling locations will be installed at Building 1037.
    - Per Ohio EPA guidance – building >5,000 ft² does not require biased samples.
  - Indoor Air sample will be collected to characterize background indoor air conditions of Building 1037.
  - Ambient Air will be collected to characterize atmospheric/upgradient background air outside of Building 1037.
  - Two sampling events will be completed to assess temporal and spatial variations at the site for any VOC constituents that are detected during the first event.
  - VOCs will be analyzed USEPA Method TO-15.
  - Screening Levels – Developed from U.S. EPA VISL Calculator
    - HQ = 0.1 and ILCR = 1 × 10-6

CC RVAAP-69

Building 1048 Fire Station

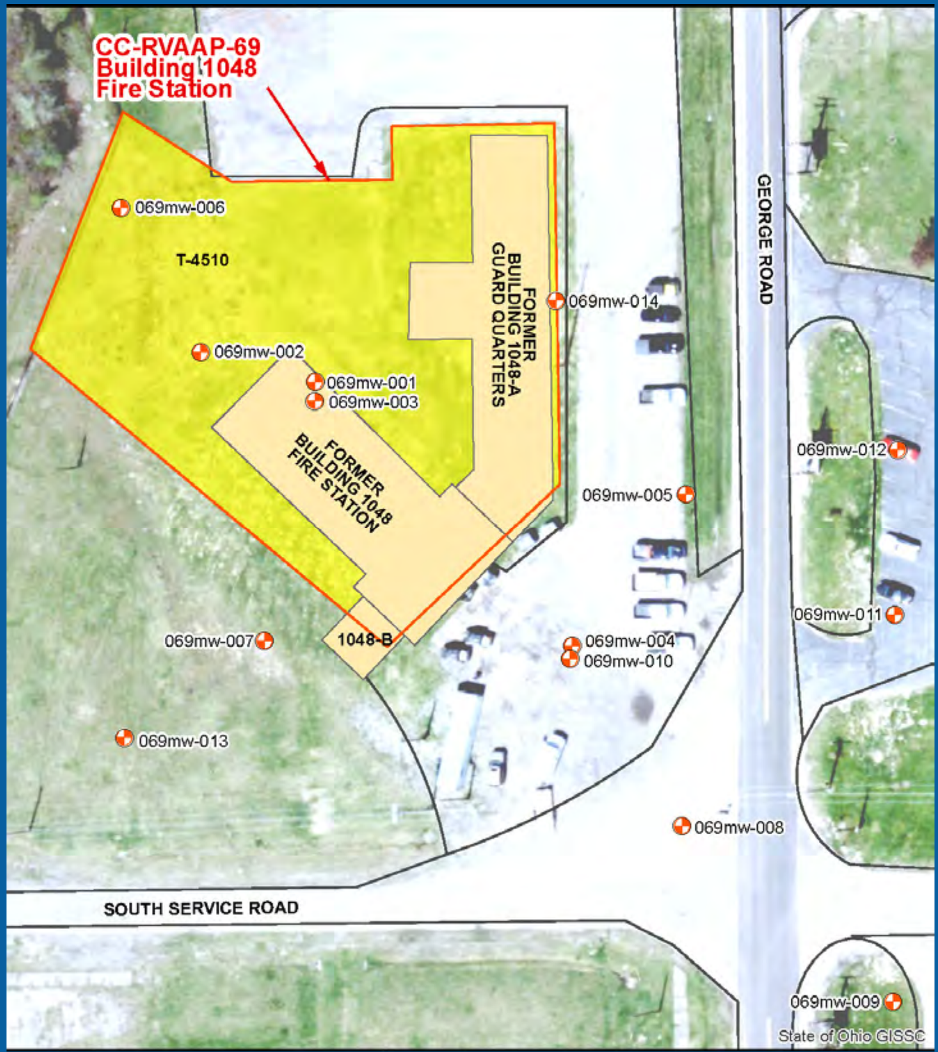
Vapor Intrusion Sampling Locations at Building 1037



CC RVAAP-69
Building 1048 Fire Station

- **Groundwater Sampling**
  - 14 existing monitoring wells at CC RVAAP-69 Building 1048 Fire Station.
  - 3 existing monitoring wells at CC RVAAP-74 Motor Pool Hydraulic Lift (downgradient of CC RVAAP-69).
  - One sampling event to analyze for the site groundwater COCs (carbon tetrachloride and chloroform).
  - Screening Levels – Developed from U.S. EPA VISL Calculator
  - HQ = 0.1 and ILCR = 1 × 10-6

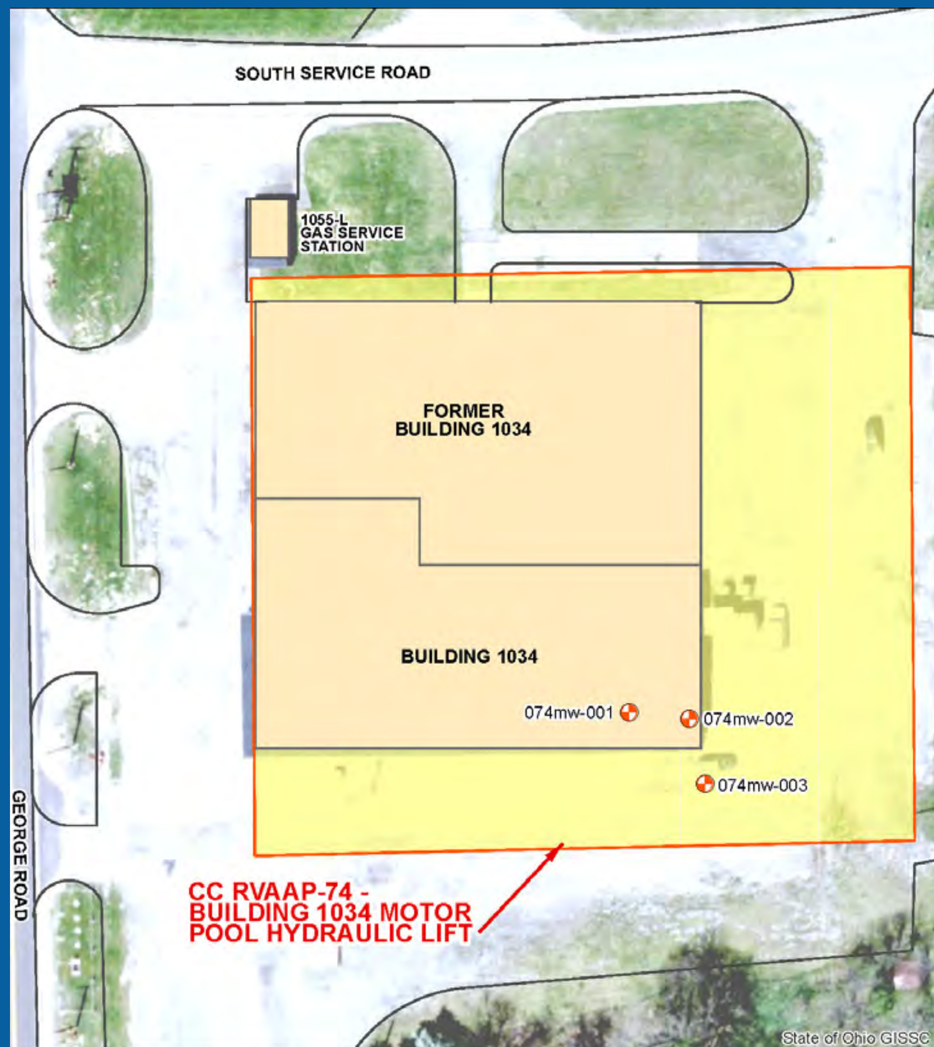
CC RVAAP-69
Building 1048 Fire Station
Groundwater Sampling Locations at Building 1048



CC RVAAP-69

Building 1048 Fire Station

Groundwater Sampling Locations at Building 1034



Questions?

CC RVAAP-78

Quarry Pond Surface Dump
Remedial Investigation of Asbestos

- **Driver of Remedial Investigation of Asbestos?**
  - Non Time-Critical Removal Action (NTCRA) completed at Debris Pile C at the Quarry Pond Surface Dump in 2020.
    - NTCRA was scoped to remove asbestos-contaminated soil.
    - NTCRA discovered previously unidentified and unexpected ACM in the excavation.
- **Goal of RI of Asbestos at Quarry Pond Surface Dump**
  - Visually identify friable Asbestos Containing Material (ACM) in the subsurface.
  - Complete horizontal and vertical delineation of ACM in and around Debris Pile C.
  - Prepare an RI Report that recommends the horizontal and vertical extent of friable ACM removal to protect human health and the environment.

CC RVAAP-78

Quarry Pond Surface Dump
Remedial Investigation of Asbestos

- **Project CUGs**

Analyte	Method	CAS Number	Screening Value	Source	Sensitivity	Units
Asbestos	PLM CARB 435 (Level B)	1332-21-4	1%	USEPA Target Level	0.25*	%

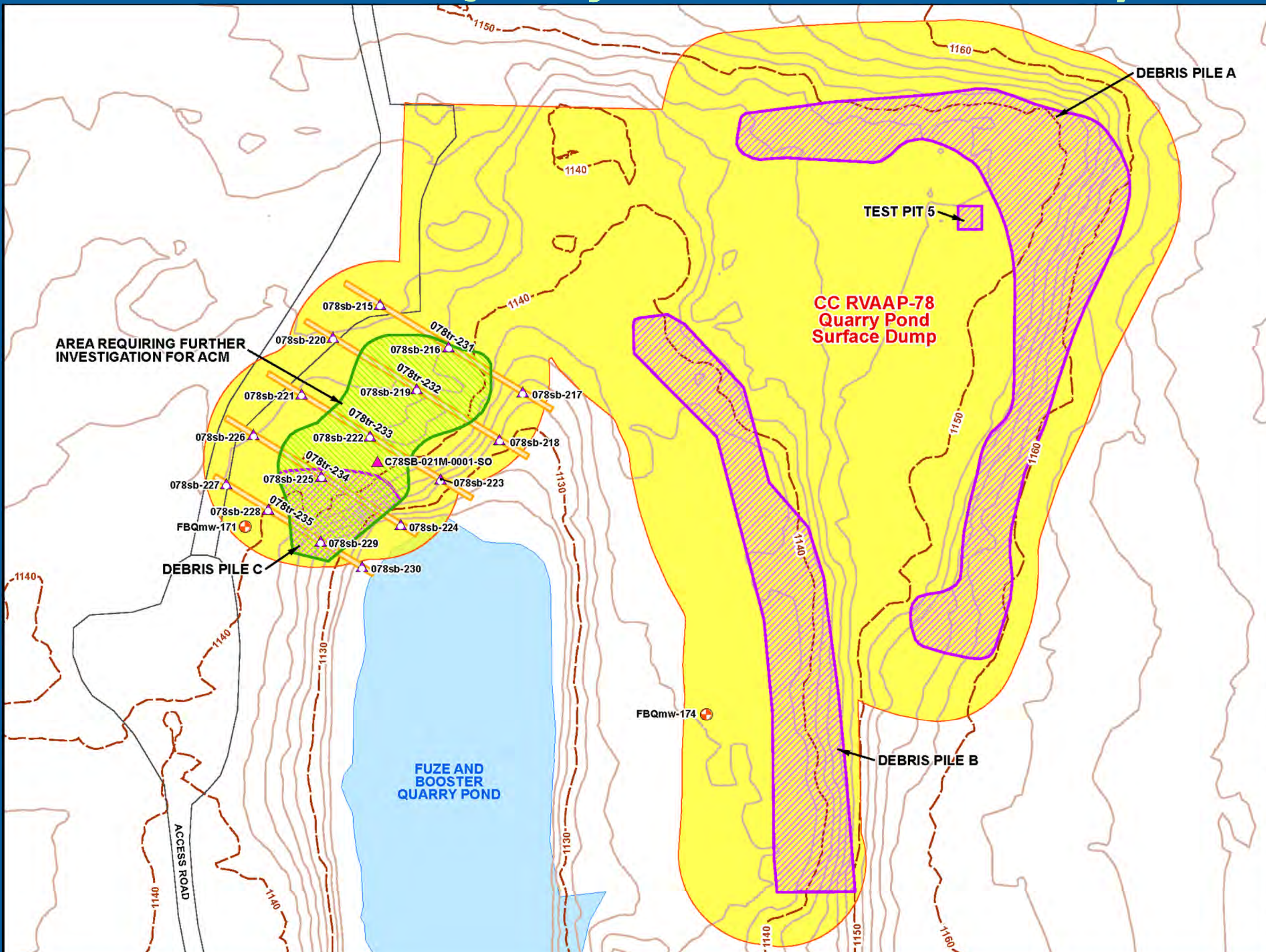
- **Proposed delineation sampling**

RVAAP AOC	Site Name	Trenches	Soil Samples	
			Surface	Subsurface
CC RVAAP-78	Quarry Pond Surface Dump	5	14	96

- Trench sampling
  - 5 trenches will transect Debris Pile C from northwest to southeast.
  - Each trench will initiate 30 ft outside the extent of the debris pile and will terminate 30 ft outside the extent of the debris pile.
  - Trench dimensions – width of an excavator bucket, depth to 14 ft bgs.
    - Resident Receptor exposure depth only extends to 13 ft bgs.
  - A Certified Asbestos Hazard Evaluation Specialist will be onsite to observe any ACM
  - Soil samples will target location of ACM, anticipated to be collected at 2 ft intervals down to 14 ft bgs.
  - Removed soil will be returned to the trenches.

CC RVAAP-78

Quarry Pond Surface Dump



LEGEND:

- ASPHALT ROAD
- CC-RVAAP-78 AOC BOUNDARY
- CAMP JAMES A. GARFIELD BOUNDARY
- GROUND CONTOUR 2-FT INTERVAL
- GROUND CONTOUR 10-FT INTERVAL
- 2021 NTCRA COMPLETED DEBRIS & SOIL REMOVAL
- 2021 NTCRA AREA REQUIRING FURTHER INVESTIGATION FOR ACM
- TRENCH
- SOIL BORING
- PROPOSED SOIL BORING
- MONITORING WELL

NOTES:

1.) THE 2020 REMEDIAL ACTION IS SUMMARIZED IN THE REMEDIAL ACTION COMPLETION REPORT, NON TIME-CRITICAL REMOVAL ACTION FOR CC RVAAP-78 QUARRY POND SURFACE DUMP (PARS 2021).

2.) DEBRIS AND SOIL REMOVAL IN DEBRIS PILE C OCCURRED FROM 0 TO 1.5 FEET BGS IN THE AREA INDICATED. IN ADDITION ASBESTOS IMPACTED SOIL WAS EXCAVATED TO APPROXIMATELY 13 FT BGS AT THE SOUTHWEST CORNER OF SAMPLE C78SB-021M-001-SO AND ACM WAS STILL OBSERVED AT THE BASE OF THE EXCAVATION. IN AN ATTEMPT TO FIND THE SOUTHERN LIMITS OF THE DEBRIS PILE, EXCAVATION CONTINUED TO APPROXIMATELY 15 FT TO THE SOUTH OF THE SOIL EXCAVATION LIMITS. ACM WAS OBSERVED BETWEEN 3 TO 8 FT BGS IN ALL THREE OF THE EXCAVATION SIDEWALLS.

3.) NO FURTHER ACTION IS REQUIRED FOR DEBRIS PILES A & B.

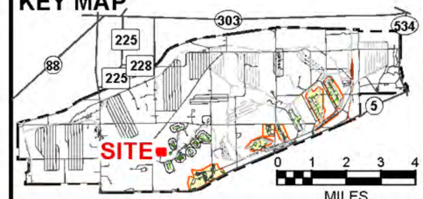
ACRONYMS:

- ACM: ASBESTOS-CONTAINING MATERIAL
- BGS: BELOW GROUND SURFACE
- CC: COMPLIANCE-RELATED CLEANUP PROGRAM
- NTCRA: NON-TIME-CRITICAL REMOVAL ACTION
- RVAAP: RAVENNA ARMY AMMUNITION PLANT

TN STATE PLANE NAD83 FEET

0 25 50 75 100 FEET

KEY MAP



U.S. ARMY CORPS OF ENGINEERS® LOUISVILLE DISTRICT

leidos

FORMER RVAAP/ CAMP JAMES A. GARFIELD PORTAGE/TRUMBLE COUNTIES, OHIO

DRAWN BY:	REQUESTOR:	DATE:	UNITS:
R. BEELER	SARAH KOSBAB	JUN 06, 2023	FEET

GIS FILE: \\chs-fs01\CAD\19009\MXD\U31_RAV78_TRENCH-01.mxd

Questions?

Multiple Areas of Concern
NACA Test Area, LL-9, WSA, Depot Area Additional Remedial Design Sampling

- **Driver of additional sampling?**
  - Confirmation sampling completed under the *Remedial Action Completion Report for Soil, Sediment, and Surface Water at Multiple Areas of Concern* (Alaniz-Endpoint 2022) determined that project Cleanup Goals (CUGs) were not achieved at excavations for 4 AOCs.
    - RVAAP-38 NACA Test Area: Area 1, Area 2, and Area 2
    - RVAAP-42 Load Line 9: Area 1 and Area 2
    - RVAAP-45 Wet Storage Area: Area 1 and Area 2
    - CC RVAAP-76 Depot Area: Building U-4 and Building U-5
- **Goal of RD sampling**
  - Develop an Addendum to the RD for each of the four AOCs that presents the results of the additional RD sampling and provides recommendations for the extent of soil removal required to achieve the CUGs of their respective RA.

Multiple Areas of Concern
RVAAP-38 NACA Test Area
Additional Remedial Design Sampling

- **Project CUGs**

AOC	Area	Chemical of Concern	Cleanup Goal (mg/kg)*
RVAAP-38 NACA Test Area	Area 1	Benz(a)anthracene	11
		Benzo(a)pyrene	1.1
		Benzo(b)fluoranthene	11
		Dibenz(a,h)anthracene	1.1
		Indeno(1,2,3-cd)pyrene	11
	Area 2	Benz(a)anthracene	11
		Benzo(a)pyrene	1.1
		Benzo(b)fluoranthene	11
		Dibenz(a,h)anthracene	1.1
	Area 3	Benzo(a)pyrene	1.1

- **Exceedances**
  - Area 1: benzo(a)pyrene – north sidewall of excavation
  - Area 2: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene – All sidewalls of excavation
  - Area 3: benzo(a)pyrene – floor of excavation

Multiple Areas of Concern
RVAAP-38 NACA Test Area
Additional Remedial Design Sampling

- **Proposed RD Sampling Breakdown**

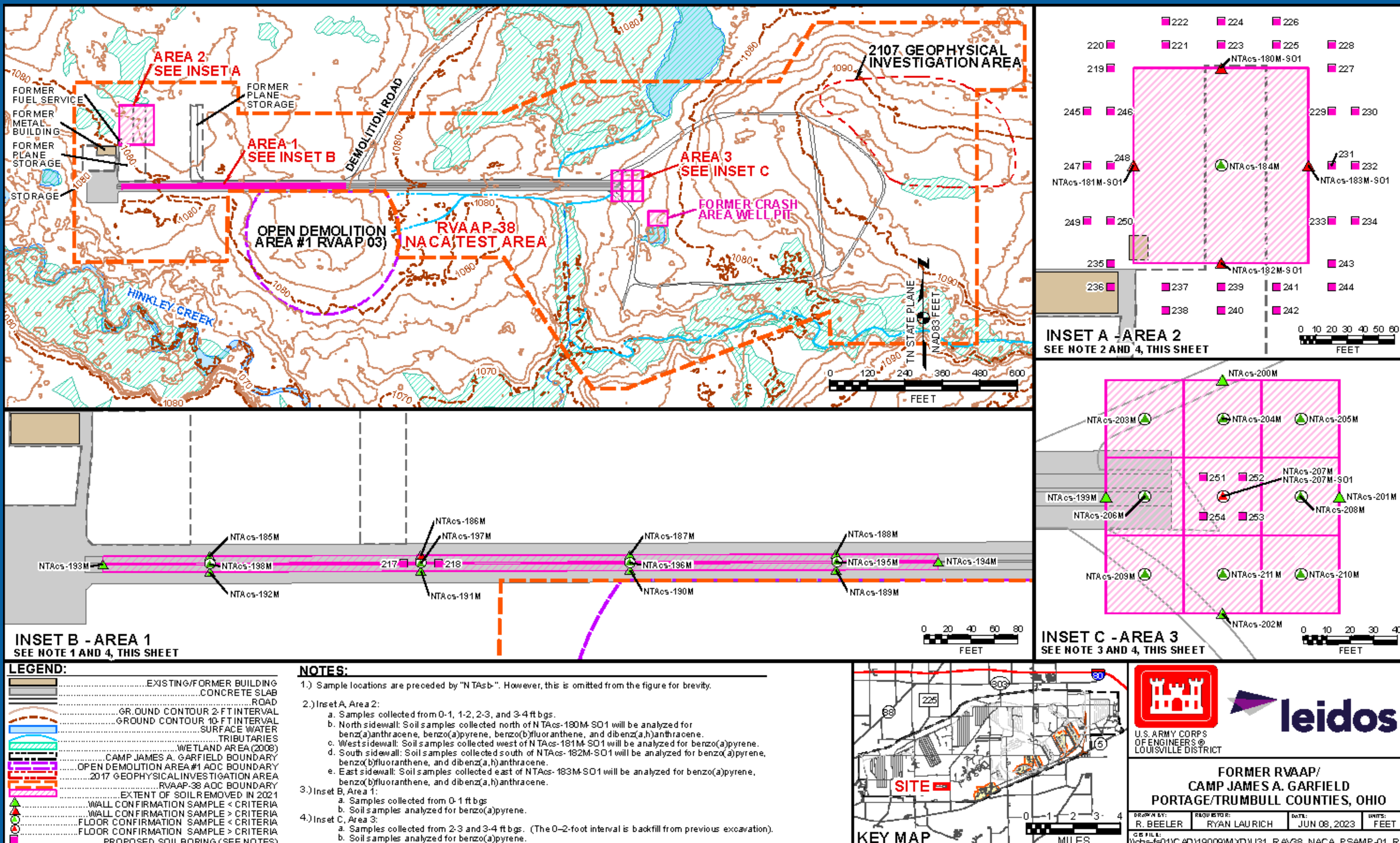
RVAAP AOC	Excavation Area	Soil Borings	Soil Samples	
			Surface	Subsurface
RVAAP-38 NACA Test Area	Area 1	2	2	0
RVAAP-38 NACA Test Area	Area 2	32	32	96
RVAAP-38 NACA Test Area	Area 3	4	0	8

- **Soil Samples**
  - Surface: 0-1 ft bgs
  - Subsurface: 1 ft intervals down to 4 ft bgs
- **Sampling Analytes**
  - Area 1: benzo(a)pyrene
  - Area 2: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene
  - Area 3: benzo(a)pyrene

Multiple Areas of Concern

RVAAP-38 NACA Test Area

Exceedances and Proposed RD Sampling



Multiple Areas of Concern

RVAAP-42 Load Line 9
Additional Remedial Design Sampling

- **Project CUGs**

AOC	Area	Chemical of Concern	Cleanup Goal (mg/kg)*
RVAAP-42 Load Line 9	Area 1	Lead	400
		Mercury	22.7
	Area 2	Benz(a)anthracene	11
		Benzo(a)pyrene	1.1
		Benzo(b)fluoranthene	11
		Dibenz(a,h)anthracene	1.1

- **Exceedances**
  - Area 1: lead and mercury – east and west sidewalls of excavation
  - Area 2:
    - benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene – Southeast sidewall of excavation
    - benzo(a)pyrene – southwest sidewall of excavation

Multiple Areas of Concern
RVAAP-42 Load Line 9
Additional Remedial Design Sampling

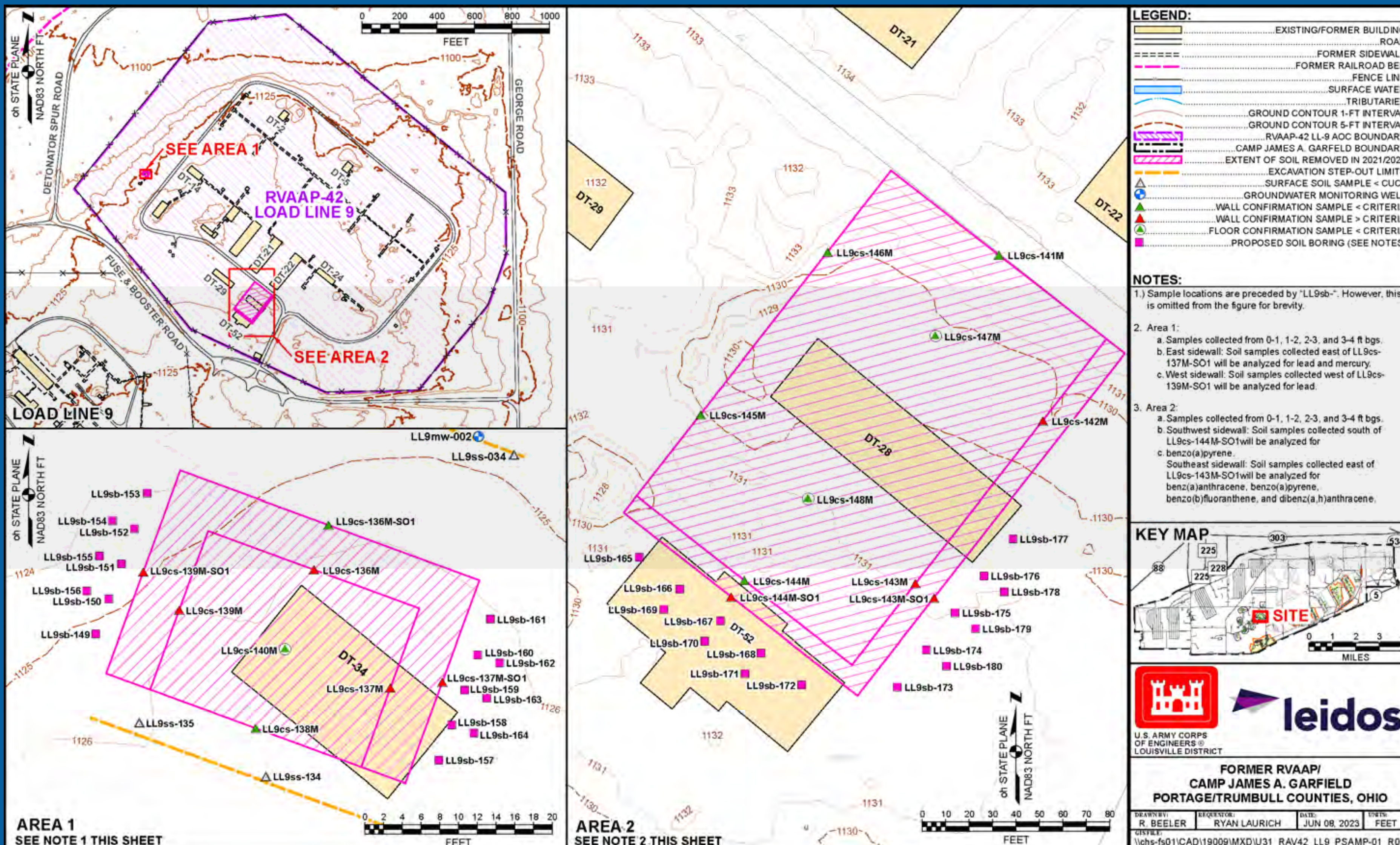
- **Proposed RD Sampling Breakdown**

RVAAP AOC	Excavation Area	Soil Borings	Soil Samples	
			Surface	Subsurface
RVAAP-42 Load Line 9	Area 1	16	16	48
RVAAP-42 Load Line 9	Area 2	16	16	48

- **Soil Samples**
  - Surface: 0-1 ft bgs
  - Subsurface: 1 ft intervals down to 4 ft bgs
- **Sampling Analytes**
  - Area 1: lead and mercury
  - Area 2:
    - benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene – southeast sidewall
    - benzo(a)pyrene – southwest sidewall

Multiple Areas of Concern

RVAAP-42 Load Line 9
Exceedances and Proposed RD Sampling



Multiple Areas of Concern
RVAAP-45 Wet Storage Area
Additional Remedial Design Sampling

- **Project CUGs**

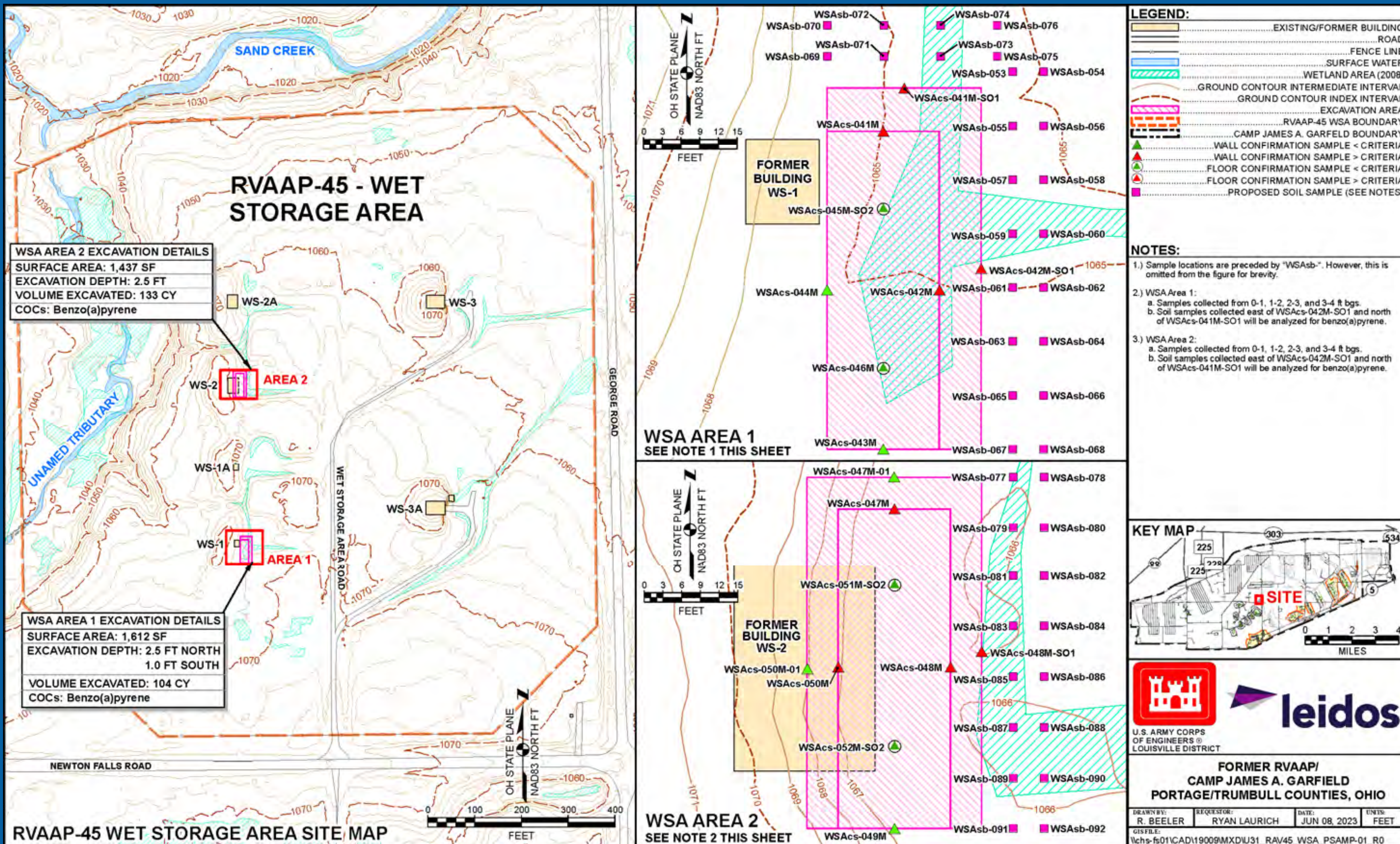
AOC	Area	Chemical of Concern	Cleanup Goal (mg/kg)*
RVAAP-45 West Storage Area	WSA Area 1	Benzo(a)pyrene	1.1
	WSA Area 2	Benzo(a)pyrene	1.1

- **Exceedances**
  - Area 1: benzo(a)pyrene – north and east sidewalls of excavation
  - Area 2: benzo(a)pyrene – east sidewall of excavation
- **Proposed RD Sampling Breakdown**

RVAAP AOC	Excavation Area	Soil Borings	Soil Samples	
			Surface	Subsurface
RVAAP-45 Wet Storage Area	Area 1	24	24	72
RVAAP-45 Wet Storage Area	Area 1	16	16	48

- **Soil Samples**
  - Surface: 0-1 ft bgs
  - Subsurface: 1 ft intervals down to 4 ft bgs
- **Sampling Analytes**
  - Area 1 and Area 2: benzo(a)pyrene

Multiple Areas of Concern
RVAAP-45 Wet Storage Area
Exceedances and Proposed RD Sampling



Multiple Areas of Concern
CC RVAAP-76 Depot Area
Additional Remedial Design Sampling

- **Project CUGs**

AOC	Area	Chemical of Concern	Cleanup Goal (mg/kg)*
CC RVAAP-76 Depot Area	Building U-4	Benz(a)anthracene	11
		Benzo(a)pyrene	1.1
		Benzo(b)fluoranthene	11
		Dibenz(a,h)anthracene	1.1
	Building U-5	Benz(a)anthracene	11
		Benzo(a)pyrene	1.1
		Benzo(b)fluoranthene	11
		Dibenz(a,h)anthracene	1.1

- **Exceedances**
  - Building U-4: benzo(a)pyrene – north and east sidewalls of excavation
  - Building U-5:
    - benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene – north sidewall of excavation
    - benzo(a)pyrene and dibenz(a,h)anthracene – south sidewall of excavation.

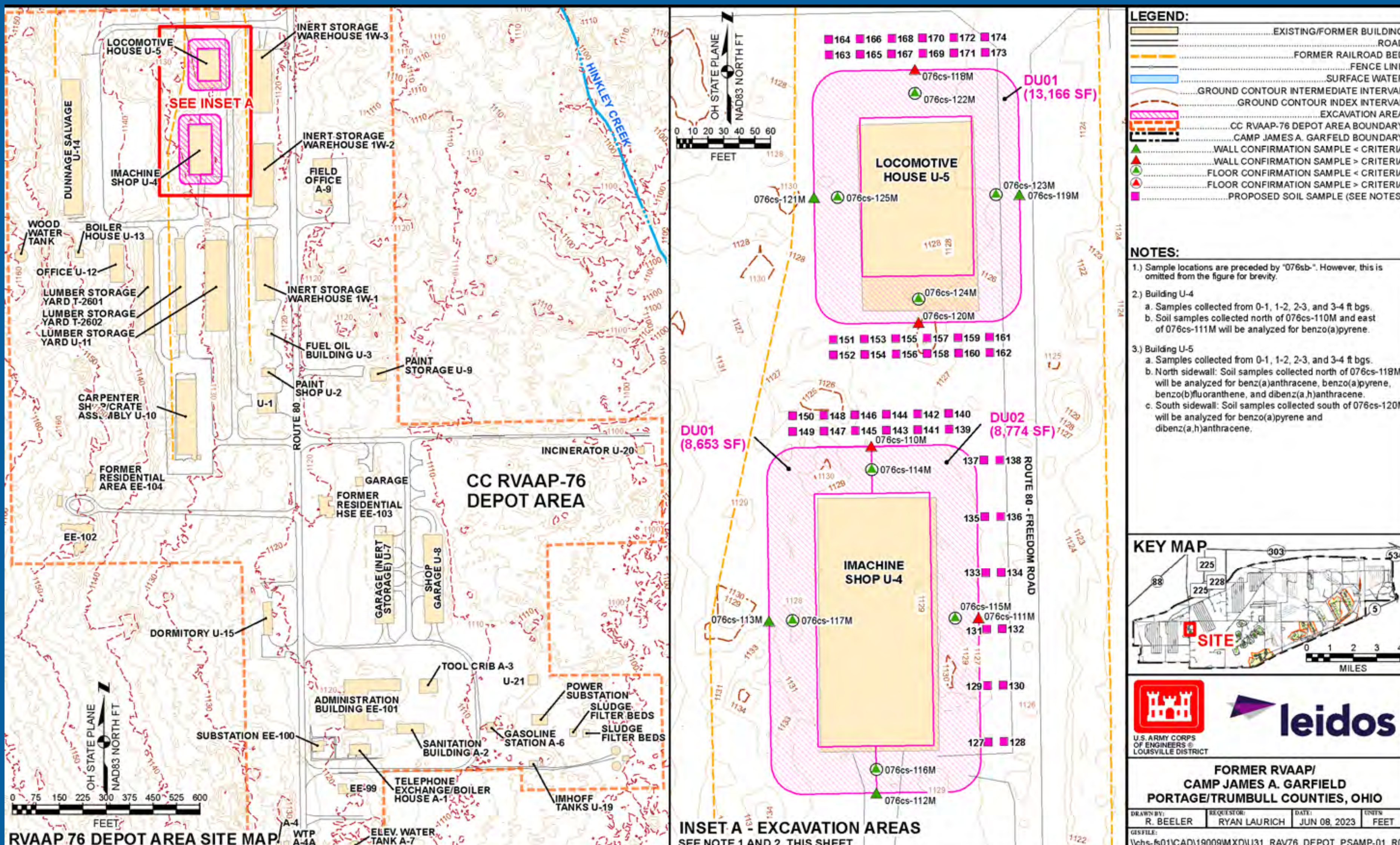
Multiple Areas of Concern
CC RVAAP-76 Depot Area
Additional Remedial Design Sampling

- **Proposed RD Sampling Breakdown**

RVAAP AOC	Excavation Area	Soil Borings	Soil Samples	
			Surface	Subsurface
CC RVAAP-76 Depot Area	Building U-4	24	24	72
CC RVAAP-76 Depot Area	Building U-5	24	24	72

- **Soil Samples**
  - Surface: 0-1 ft bgs
  - Subsurface: 1 ft intervals down to 4 ft bgs
- **Sampling Analytes**
  - Building U-4: benzo(a)pyrene
  - Building U-5:
    - benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene – north sidewall
    - benzo(a)pyrene and dibenz(a,h)anthracene – south sidewall

Multiple Areas of Concern
CC RVAAP-76 Depot Area
Exceedances and Proposed RD Sampling



Questions?

APPENDIX F

OHIO EPA CORRESPONDENCE

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Received March 20, 2025

March 20, 2025

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Restoration Program Manager
ARNG-ILE Clean Up
Camp James A Garfield JTC
1438 State Route 534 SW
Newton Falls, OH 44444

RE: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859216

Sent via email to: Kevin.m.sedlak.ctr@army.mil

Subject: Former Ravenna Army Ammunition Plant
Responses to Comments on the Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump
Ohio EPA - Request for Final Document

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the Army's Responses to Comments on the Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, CC RVAAP-78 Quarry Pond Surface Dump. The draft UFA-QAPP was received at Ohio EPA's (NEDO), Division of Environmental Response and Revitalization (DERR) via email on October 15th, 2024[1], and on December 11th, 2024, Ohio EPA provided comments on the draft UFA-QAPP[2]. Ohio EPA received the Army's Response to Comments for the UFP-QAPP via email on January 7, 2025[3].

Based on our review of the Responses to Ohio EPA comments provided in your letter dated January 7, 2025, we find the responses generally acceptable, and the document can be finalized. Please be sure that all agreed-upon changes, additions, and clarifications are

---

[1] http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=3261773
[2] http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=3386436
[3] http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=3373588

provided in the final document.

If you have any questions, please contact me at (330) 963-1109, or via email at craig.kowalski@epa.ohio.gov.

Sincerely,

Craig Kowalski

Craig Kowalski
Site Coordinator
Division of Environmental Response and Revitalization

CK/cm

ec: Katie Tait, OHARNG RTLS, CJAG
Megan Oravec, Ohio EPA, NEDO DERR
Natalie Oryshkewych, Ohio EPA, NEDO DERR
Thomas Schneider, Ohio EPA, SWDO DERR

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

January 7, 2025

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Mr. Craig Kowalski
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Responses to Comments on the Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump (Work Activity No. 267-000-859-216)

Dear Mr. Kowalski:

The Army appreciates your comments on the *Draft Uniform Federal Policy-Quality Assurance Project Plan for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump*. Enclosed for your review are responses to your comments. Upon final resolution of the comments, the Army will provide a Final version of the report for Ohio EPA concurrence.

These comment responses were prepared for the Army National Guard in support of the RVAAP Restoration Program. Please contact the undersigned at 330.235.2153 or kevin.m.sedlak.ctr@army.mil if there are issues or concerns with this submission.

Sincerely,

TAIT.KATHRYN.SERENA.1289508275 Digitally signed by TAIT.KATHRYN.SERENA.1289508275 Date: 2025.01.07 07:07:03 -05'00'

FOR Kevin M. Sedlak
Restoration Project Manager
Army National Guard Directorate

ec: Megan Oravec, Ohio EPA
Thomas Schneider, Ohio EPA
Katie Tait, OHARNG
Steve Kvaal, USACE Louisville
Jeremy Renner, USACE Louisville
Jennifer Tierney, Chenega, Admin Record
Jed Thomas, Leidos
Ryan Laurich, Leidos

Subject: Former Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Draft Uniform Federal Policy-Quality Assurance Project Plan for Remedial Investigation of Asbestos at CC RVAAP-78 Quarry Pond Surface Dump (Work Activity No. 267-000-859-216)

COMMENTS

Ohio EPA Comment 1: Section 11.2.5 Describes (CAHES) Certified Asbestos Hazard Evaluation Specialist will assess the condition of the asbestos containing material (ACM), which in turn will determine if it is friable or nonfriable. It is intended for trenching to be conducted until the extent of ACM is established.

Section 18.3.5 Describes determine if suspect ACM is uncovered during excavation activities. The CAHES will sample suspect ACM and provide a condition grade to determine if the material is friable. Soils that are removed during trenching will be placed on plastic sheeting, wetted as necessary to prevent generating dust, and covered with plastic sheeting until the trench is complete and the soils can be put back. At the completion of the investigation, the trenches will be abandoned by refilling the trenches with the excavated soil.

Action Item: Please confirm that the CAHES is certified by the State of Ohio (Ohio EPA) with a valid certificate to perform Asbestos Sampling and/or Oversite duties that are applicable to the certification.

> *Army Response*: Agree. The first callout of the CAHES (Section 11.2.3 – fourth bullet in list) has been revised to include the language provided under the Action Item for this comment and reads as follows:
>
> Field observations made during trenching activities per this UFP-QAPP made by a Certified Asbestos Hazard Evaluation Specialist (CAHES). The CAHES will be certified by the State of Ohio (Ohio EPA) with a valid certificate to perform asbestos sampling and/or oversight duties that are applicable to the certification.

Ohio EPA Comment 2: Sections 15.1 Asbestos-Containing Soil and 17.2 Sampling Areas and Rational, discuss using both visual determination and soil sample results above 1% asbestos as the criteria for determining the extent of ACM in area C of RVAAP-78 Quarry Pond Surface Dump. Following the investigation described in the QAPP, a summary of the results describing the extent and volume of ACM, asbestos contaminated soil, and the area of concern (AOC) history will be provided in a remedial investigation (RI) report. Section 17.2 states the RI will be produced without a risk assessment section as the project will move directly into a feasibility study to evaluate remedial alternatives to address ACM contamination.

Action Item: Clarify in the revised QAPP that the results of the investigation will be included in a combined RI/FS or another document (e.g., streamlined FS) and that potential risk from visual ACM and contaminated soil above 1% asbestos will be considered unacceptable, requiring a remedy for area C in the AOC. The combined RI/FS or other document will also evaluate appropriate remedial alternatives for reaching cleanup goals at area C in RVAAP-78 Quarry Pond Surface Dump.

> *Army Response*: Clarification and agree. Agreed to during the November 7, 2024 conference call with Ohio EPA, the Army, and Leidos, the results of the investigation will be included in a combined RI/FS. The RI portion of the report will present the results of this investigation and will not require calculation of risks. The FS portion of the report will develop and evaluate remedial alternatives to address all ACM and asbestos-contaminated soil required to achieve project cleanup

goals in Debris Pile C. The following sections of the UFP-QAPP have been revised to indicate the path forward is a combined RI/FS Report: Introduction (Scope – first paragraph, and Project Objectives – third bullet), Worksheet #11 (Section 11.2.2 – third bullet, Section 11.3.2 – third bullet, and Section 11.3.6 – first paragraph), and Worksheet #17 (Section 17.2 – second paragraph).

December 11, 2024

Received December 12, 2024

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Camp James A. Garfield JMTC
Attn: Environmental Office (Bldg 1071)
8451 State Route 5
Ravenna OH 44266

Sent via email to:
Kevin.m.sedlak.ctr@army.mil

RE: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Investigation
Remedial Response
Portage County
ID # 267000859216

Subject: Former Ravenna Army Ammunition Plant
Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), CC RVAAP-78
Quarry Pond Surface Dump
Ohio EPA Comments

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Draft Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), CC RVAAP-78 Quarry Pond Surface Dump[1]. This document was received at Ohio EPA's (NEDO), Division of Environmental Response and Revitalization (DERR) via email on October 16th, 2024.

Comments on the document based on Ohio EPA review are provided below. Please provide responses to the enclosed comments in accordance with the Directors Findings and Orders.

Comment 1:

Section 11.2.5 Describes *(CAHES) Certified Asbestos Hazard Evaluation Specialist* will assess the condition of the asbestos containing material (ACM), which in turn will determine if it is friable or non-friable. It is intended for trenching to be conducted until the extent of ACM is established.

Section 18.3.5 Describes determine if suspect ACM is uncovered during excavation activities. The CAHES will sample suspect ACM and provide a condition grade to determine if the material is friable.

[1] http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=3261773

Soils that are removed during trenching will be placed on plastic sheeting, wetted as necessary to prevent generating dust, and covered with plastic sheeting until the trench is complete and the soils can be put back. At the completion of the investigation, the trenches will be abandoned by refilling the trenches with the excavated soil.

Action Item: Please confirm that the CAHES is certified by the State of Ohio (Ohio EPA) with a valid certificate to perform Asbestos Sampling and/or Oversite duties that are applicable to the certification.

Comment 2:

Sections 15.1 Asbestos-Containing Soil and 17.2 Sampling Areas and Rational, discuss using both visual determination and soil sample results above 1% asbestos as the criteria for determining the extent of ACM in area C of RVAAP-78 Quarry Pond Surface Dump. Following the investigation described in the QAPP, a summary of the results describing the extent and volume of ACM, asbestos contaminated soil, and the area of concern (AOC) history will be provided in a remedial investigation (RI) report. Section 17.2 states the RI will be produced without a risk assessment section as the project will move directly into a feasibility study to evaluate remedial alternatives to address ACM contamination.

Action Item: Clarify in the revised QAPP that the results of the investigation will be included in a combined RI/FS or another document (e.g., streamlined FS) and that potential risk from visual ACM and contaminated soil above 1% asbestos will be considered unacceptable, requiring a remedy for area C in the AOC. The combined RI/FS or other document will also evaluate appropriate remedial alternatives for reaching cleanup goals at area C in RVAAP-78 Quarry Pond Surface Dump.

If you have any questions, please contact me at (330) 963-1109, or via email at craig.kowalski@epa.ohio.gov.

Sincerely,

Craig Kowalski

Craig Kowalski
Site Coordinator
Division of Environmental Response and Revitalization

CK/cm

ec: Katie Tait, OHARNG RTLS, CJAG
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