DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

October 4, 2021

DAIM-ODB-LO

Mr. Brian Folllin
US Environmental Protection Agency, R6
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

Re: Final UFP-QAPP, LHAAP-17 Burning Ground No.2/Flashing Area Group 2, Time Critical Removal Action for Munitions and Explosives of Concern (MEC), Longhorn Army Ammunition Plant, Karnack, Texas, October 2021

Dear Mr. Follin,

The above-referenced document is being transmitted to you for your records and includes revisions based upon your comments on the August 2021 Draft Final.

The document was prepared by Munitions Management Group-TLI Solutions Joint Venture (MMG-TLI JV) on behalf of the Army as part of MMG-TLI JV's Performance Based Remediation contract for the facility. I ask that Kyra Donnell, MMG-TLI-JV's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.zeiler@calibresys.com.

Sincerely,

Rose M - Zeiler

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX
P. Bruckwicki, Caddo Lake NWR, TX
A. Williams, USACE, Tulsa District, OK
A. Nieves, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

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RATCLIFF, AR 72951

October 4, 2021

DAIM-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final UFP-QAPP, LHAAP-17 Burning Ground No.2/Flashing Area Group 2, Time Critical Removal Action for Munitions and Explosives of Concern (MEC), Longhorn Army Ammunition Plant, Karnack, Texas, October 2021

Dear Ms. Palmie,

The above-referenced document is being transmitted to you for your records and includes revisions based upon your comments on the August 2021 Draft Final.

The document was prepared by Munitions Management Group-TLI Solutions Joint Venture (MMG-TLI JV) on behalf of the Army as part of MMG-TLI JV's Performance Based Remediation contract for the facility. I ask that Kyra Donnell, MMG-TLI-JV's Project Manager, be copied on any communications related to the project.

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Sincerely,

Rose M. Zeiler

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FINAL

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) WITH MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

October 2021

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

FINAL

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

LHAAP-17 BURNING GROUND NO. 2/FLASHING AREA GROUP 2 TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) WITH MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, KARNACK, TEXAS

Prepared for:

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
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Contract No. W9128F18D0001

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Table of Contents

Figures

(All listed figures are located at the end of the UFP-QAPP before the Appendices)

Appendices

Acronyms and Abbreviations

AAR	After Action Report
ADR	automated data review
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirement
Army	United States Army
ARNG	Army National Guard
ATF	Bureau of Alcohol, Tobacco, and Firearms
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
Bhate	Bhate Environmental Associates, Inc.
BHHRA	Baseline Human Health Risk Assessment
BIP	blown-in-place
BRAC	Base Realignment and Closure
BS	Bachelor of Science
°C	degrees Celsius
CA	Corrective Action
CAA	Clean Air Act
CAG	Citizens Advisory Group
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CD	compact disk
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIP	Community Involvement Plan
CLIN	Contract Line Item Number
cm	centimeter
CO	Contract Officer
COC	chemical of concern
COEC	chemical of ecological concern
CQCS	Contractor Quality Control Supervisor
CQM	Construction Quality Management
CSM	Conceptual Site Model
CTE	central tendency exposures
CWA	Clean Water Act
CWM	Chemical Warfare Materiel
CY	cubic yard
DCA	dichloroethane
DCE	dichloroethene
DD	Decision Document
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DESR	Defense Explosive Safety Regulation

DFW	definable feature of work
DGM	digital geophysical mapping
DMM	discarded military munitions
DNT	dinitrotoluene
DoD	Department of Defense
DoDI	Department of Defense Instruction
DPT	direct-push technology
DQCR	Daily Quality Control Report
DQI	Data Quality Indicator
DQO	Data Quality Objective
DU	Decision Unit
DUA	data usability assessment
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
EM	Engineering Manual
EMM	earth moving machinery
EM61	EM61-MK2
EMP	Explosives Management Plan
EOD	Explosive Ordnance Disposal
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
ERM	Environmental Restoration Manager
EPP	Environmental Protection Plan
ERA	Ecological Risk Assessment
ERAGS	Ecological Risk Assessment Guidance
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
ESL	ecological screening level
ESS	Explosives Safety Submission
ESTCP	Environmental Security Technology Certification Program
°F	degrees Fahrenheit
FCR	Field Change Request
FD	field duplicate
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
GSV	Geophysical System Verification
HAZWOPER	Hazardous Waste Operations and Emergency Response
HD	high-density
HDPE	high density polyethylene pipe
HE	high explosive
HHRA	Human Health Risk Assessment
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High Performance Liquid Chromatography

HQ	Hazard Quotient
HTRW	Hazardous, Toxic and Radioactive Waste
Hz	hertz
IAW	in accordance with
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
IRP	Installation Restoration Program
ISO	Industry Standard Object
ITS	instrument test strip
IVS	instrument verification strip
IWWP	Installation Wide Work Plan
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LHAAP	Longhorn Army Ammunition Plant
LOD	limit of detection
LOQ	limit of quantitation
LUC	land use control
m	meter
MB	method blank
MBA	Master of Business Administration
MC	munitions constituents
MCL	Maximum Contaminant Level
MD	munitions debris
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	Munitions and Explosives of Concern
MFD	maximum fragmentation distance
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MMG-TLI JV	Munitions Management Group-TLI Solutions Joint Venture
MMR	Military Munitions Response
MMRP	Military Munitions Response Program
MNA	monitored natural attenuation
MOA	Memorandum of Agreement
MPC	Measurement Performance Criteria
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	measurement quality objective
MR-QAPP	Munitions Response-Quality Assurance Project Plan
MS	matrix spike
MSC	medium-specific concentration
MSD	matrix spike duplicate
mV	millivolt

NA	Not Applicable
NAOC	National Association of Ordnance Contractors
NCAR	Non-Conformance and Corrective Action Report
NCP	National Oil and Hazardous Substances Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NEPA	National Environmental Policy Act
NFA	No Further Action
NMRD	non-munitions related debris
NPL	National Priorities List
NRL	Naval Research Laboratory
NS	No Screening
NWOC	National Water Quality Criterion
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
PBR	Performance-Based Remediation
PCBs	polychlorinated biphenyls
PDI	pre-design investigation
PDT	Project Delivery Team
PEC	Planteco Environmental Consultants, LLC
PETN	pentaerythritol tetranitrate
PLS	Professional Land Surveyor
PM	Project Manager
PMP	Project Management Plan
POC	point of contact
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
QSM	Quality Systems Manual
RAB	Restoration Advisory Board
RACR	Remedial Action Completion Report
RAGS	Risk Assessment Guidance for Superfund
RC	response complete
RCA	root cause analysis
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RD/RAWP	Remedial Design/Remedial Action Work Plan
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RECAP	Risk Evaluation/Corrective Action Program
RFI	RCRA Facility Assessment
RI	Remedial Investigation
RME	reasonable maximum exposures
RMS	root-mean-squared
ROD	Record of Decision
RPD	relative percent difference
RPEC	United States Army Corps of Engineers Regional Planning and Environmental Center

RSD	relative standard deviation
RSL	Regional Screening Level
RT	retention time
RTK	real-time kinematic
RTS	Robotic Total Station
SARA	Superfund Amendments and Reauthorization Act
SC	site closeout
SEDD	Staged Electronic Data Deliverable
Shaw	Shaw Environmental, Inc.
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SRA	saturated response area
SRM	Standard Reference Material
SS	Screening Standard
SSHP	Site Safety and Health Plan
STEP	Solutions to Environmental Problems, Inc.
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	semivolatile organic compounds
SWMU	solid waste management unit
TBD	to be determined
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TCEQ	Texas Department of Environmental Quality
TCRA	Time Critical Removal Action
TEC	toxicity equivalence concentration
Tetryl	N-methyl-n, 2,4,6-tetranitroaniline
TL	Team Lead
TLI	TLI Solutions
TM	Technical Manager
TNT	2,4,6-trinitrotoluene
TO	Task Order
TOI	target of interest
TP	Technical Paper
TPC	three phases of control
TPP	Technical Project Planning
UCL	Upper Confidence Limit
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAEHA	United States Army Environmental Hygiene Agency
USAF	United States Air Force
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOQP	Unexploded Ordnance Qualified Personnel
UXOSO	Unexploded Ordnance Safety Officer

UXOT	Unexploded Ordnance Technician
VC	vinyl chloride
VOC	volatile organic compound
VSP	Visual Sampling Plan
WMP	Waste Management Plan

Executive Summary

This Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) has been prepared in support of a Time Critical Removal Action (TCRA) to significantly reduce, mitigate or eliminate the potential threat of an encounter with Munitions and Explosives of Concern (MEC) to the public (i.e. off-path Caddo Lake National Wildlife Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016) at Longhorn Army Ammunition Plant (LHAAP) site LHAAP-17 Burning Ground No. 2/Flashing Area Group 2, Comprehensive Environmental Response, Compensation, and Liability Information System, U.S. Environmental Protection Agency (EPA) Identification Number TX6213820529 (hereinafter LHAAP-17), Karnack, Texas (**Figure ES-1**). The TCRA will be performed in accordance with a signed Action Memorandum.

LHAAP-17 is a 3.9-acre site located within a heavily wooded section in the southeastern portion of LHAAP and has two 185 feet-by-305 feet cleared areas, separated by a gravel access road. The location of LHAAP-17 within LHAAP, is shown on **Figure ES-2**. LHAAP-17 is undergoing remedial action in accordance with the final *Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack Texas*, Final, September (Shaw, 2016). Soil excavation to remove contaminated soil and installation of a groundwater extraction system are major components of the selected remedy for LHAAP-17. These activities require extensive intrusive work (i.e., digging) which introduces an imminent and substantial risk due to potential encounters with MEC. A detailed description of the remedy and its planned implementation is presented in the *Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas* (Bhate Environmental Associates, Inc. [Bhate] 2019).

Thirteen individual excavation areas (Areas A, B, C, D, E, F, G, H, J, K, L, M and N) are associated with LHAAP-17 as shown on **Figure ES-3**. Excavation activities began at LHAAP-17 in August 2019 with a goal to remove soil contaminated with 2,4,6-trinitrotouene (TNT), 2,4-dinitrotoluene (DNT), and 2,6-DNT exceeding human health criteria. A 4.2-inch Mortar was recovered in Area M on August 30, 2019 and a temporary work stoppage ordered while Explosive Ordnance Disposal (EOD) responded. The item was determined to be empty, a likely anomaly for the site, and work continued. A second empty 4.2-inch Mortar was unearthed in Area N on September 7, 2019 prompting a second work stoppage. Excavation work resumed on September 16, 2019 with an U.S. Army Corps of Engineers (USAC) Ordnance and Explosives Safety Specialist (OESS) on site to provide MEC support. The OESS subsequently located and identified hundreds of munitions items, primarily munitions debris (MD) but also including live pyrotechnic munitions items and a final work stoppage implemented to develop plans and processes to address the potential for MEC at LHAAP-17 during completion of the remedy. MEC encountered during the previous soil excavation work included two M301 81-mm illumination mortars, nine artillery base tracer elements, and one M19 series rifle-launched green parachute signal. Two 4.2-inch illumination mortars empty of energetic fill material were also recovered.

The MEC presents an explosive safety hazard to those who come into direct contact with it. The MEC also presents an explosive safety hazard to secondary receptors potentially present during accidental detonation. Further, these MEC types may have leached into site soils in the past and present a potential continuing source of perchlorate contamination.

No high explosives (HE) containing MEC have been recovered to date. MEC was recovered from both open excavations and existing soil piles. At the time of the stop work order, approximately 1,800 cubic yards (CY) of excavated soil had been stockpiled on site at LHAAP-17. All recovered MEC was destroyed by detonation on-site on September 30, 2019. Of the 13 excavation areas, seven excavations that were confirmed to be clean (Areas A, B, C, D, E, F and G) were backfilled in August 2020 as described in the *Draft Final Summary Report – Excavation and Backfill Activities at LHAAP-17* (Bhate 2021) while six (Areas H, J, K, L, M and N) remain open.

A TCRA is necessary for LHAAP-17 to safely complete remedial activities involving soil excavation to remove contaminated soil and installation of groundwater extraction system components. . The United States Army Environmental Command (USAEC) is responsible for funding the environmental restoration programs at LHAAP. The Base Realignment and Closure (BRAC) holds responsibility for administrative control and transfer of LHAAP property. The USACE, Tulsa District and the USACE Regional Planning and Environmental Center (RPEC) associated with the Fort Worth District support BRAC with contracting, technical assistance, and project quality control (QC). The U.S. Army is the lead agency for LHAAP. The EPA Region 6 and the Texas Commission on Environmental Quality (TCEQ) are the regulatory agencies providing technical support, project review and comment, and oversight of the LHAAP cleanup program. The EPA is the lead oversight agency for National Priorities List (NPL) sites, and the TCEQ is the lead oversight agency for non-NPL sites. LHAAP-17 is an NPL site.

The TCRA is being completed by Munitions Management Group-TLI Solutions Joint Venture (MMG-TLI JV) supported by team partners AECOM and Bhate Environmental Associates, Inc. (Bhate).

TCRA activities at LHAAP-17 will be performed pursuant to:

- A signed Action Memorandum
- The 1991 Federal Facilities Agreement
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA)
- National Oil and Hazardous Substances Contingency Plan (NCP) requirements
- Applicable Texas environmental regulations
- Regulatory coordination, as appropriate, with the EPA and the TCEQ
- DoD Ammunition and Explosives Safety Standards (6055.09-STD, as amended to DoD Manual 6055.09-M) and other applicable DoD guidance
- All applicable Federal, State, and local installation regulations

The objective of the TCRA at LHAAP-17 is to:

- Significantly reduce, mitigate or eliminate the potential threat of an encounter with MEC to the public (i.e. off-path Refuge visitors and trespassers) and environmental construction workers carrying out the selected remedy (i.e., soils excavation and disposal and installation of groundwater extraction system components). The objective includes options to expand the area of the TCRA beyond the current LHAAP-17 site boundaries as needed to follow the extent of contamination.

Activities to be completed during the TCRA include:

- Identify an approved backfill source and characterize soils within existing soils stockpiles
- Remove impounded water from all open excavations in Areas H, J, K, L, M and N (continue this process as needed following heavy rainfall)
- Perform civil survey (including surveying of the extent of the excavation to be completed in Areas H and J as delineated in the RD/RAWP), utility clearance, installation of the instrument verification strip (IVS) and instrument test strip (ITS)
- Verify and install storm water erosion control measures
- Establish mobile soil screening operation and material potentially presenting an explosive hazard (MPPEH) processing area, and install an explosives storage magazine

- Use remotely operated and robotic earth moving machinery (EMM) to complete intrusive activities involving soils excavation to remove contaminated media and to install groundwater extraction system components (per the requirements of the ROD [Shaw, 2016] and in accordance with the RD/RA WP [Bhate, 2019])
- Install groundwater extraction system components under supervision of UXO qualified personnel and employing anomaly avoidance procedures as appropriate
- Backfill the excavations
- Conduct all soils movement utilizing remotely operated and robotic EMM
- Assemble and verify correct operation of the Digital Geophysical Mapping (DGM) sensors and complete the initial IVS testing
- Complete brush clearance as needed and locate grids
- Perform instrument-assisted surface sweep across all grids
- Complete quality control (QC) blind seeding for DGM
- Collect DGM data (including underneath existing soil stockpiles once removed)
- Process the DGM data and select targets (i.e., subsurface anomalies) for reacquisition (i.e., relocation)
- Reacquire (i.e., relocate), remove, and inspect the selected targets
- Complete soil sampling
- Properly manage and dispose of MEC and MPPEH, if any, and all investigation-derived waste (IDW) streams
- Decontaminate equipment and restore the site

The UFP-QAPP (optimized worksheet format) is prepared in accordance with (IAW) all relevant and current guidance including the recently published Munitions Response Quality Assurance Project Plan (MR-QAPP) Toolkit (Intergovernmental Data Quality Task Force [IDQTF], 2018), which consists of a series of worksheets that contain both general and specific information about the project. This UFP-QAPP was also prepared IAW the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans* (EPA, 2005); Optimized UFP-QAPP Worksheets (EPA, 2012); and Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions* (USACE, 2015a). It also incorporates worksheet variations provided in the UFP-QAPP, MR-QAPP Toolkit, Module 1, (IDQTF, 2018).

This UFP-QAPP consists of the following worksheets that contain both general and specific information:

- Worksheets #1 & 2: Title and Approval Page
- Worksheets #3 & 5: Project Organization and Quality Assurance Project Plan Distribution
- Worksheets #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
- Worksheet #6: Communication Pathways
- Worksheet #9: Project Planning Session Summary
- Worksheet #10: Conceptual Site Model
- Worksheet #11: Project/Data Quality Objectives
- Worksheet #12: Measurement Performance Criteria
- Worksheet #13: Secondary Data Uses and Limitations
- Worksheets #14 & 16: Project Tasks and Schedule
- Worksheet #15: Screening Criteria and Laboratory-Specific Detection/Quantitation Limits

- Worksheet #17: Investigation Design and Project Work Flow
- Worksheet #18: Sampling Locations and Methods
- Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times
- Worksheet #20: Field Quality Control
- Worksheet #21: Field Standard Operating Procedures
- Worksheet #22: Equipment Testing, Inspection, and Quality Control
- Worksheet #23: Analytical Standard Operating Procedures
- Worksheet #24: Analytical Instrument Calibration
- Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection
- Worksheets #26 & 27: Sample Handling, Custody, and Disposal
- Worksheet #28: Analytical Quality Control and Corrective Action
- Worksheet #29: Data Management, Project Documents and Records
- Worksheets #31, 32 & 33: Assessments and Corrective Action
- Worksheet #34: Data Verification, Validation, and Usability Inputs
- Worksheet #35: Data Verification Procedures
- Worksheet #36: Data Validation Procedures
- Worksheet #37: Data Usability Assessment

The following appendices support this UFP-QAPP:

- Appendix A: Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP)
- Appendix B: Environmental Protection Plan (EPP)
- Appendix C: Explosives Management Plan (EMP)
- Appendix D: Waste Management Plan (WMP)
- Appendix E: Laboratory Certifications
- Appendix F: SOPs
- Appendix G: Field Forms
- Appendix H: Blind Seed Firewall Plan
- Appendix I: Table of Deviations
- Appendix J: Groundwater Extraction System Design Elements

MMG-TLI JV and AECOM SOPs (included in Appendix F) provide detailed procedures for common munitions response tasks that are non-site-specific. In the event approved plans conflict with SOPs, the conflict will be brought to the attention of the Project Delivery Team (PDT). Unless otherwise determined, approved plans take precedence over SOPs. The ESS, APP/SSHP, EPP, EMP, WMP, and Blind Seed Firewall Plan are integral to the approved UFP-QAPP. Laboratory certifications are provided to demonstrate the qualifications of the selected subcontracted laboratory. MMG-TLI JV will monitor for certification expiration/renewal throughout the life of the project. The Table of Deviations documents deviations from the QAPP template.

The TCRA at LHAAP-17 will significantly reduce, mitigate or eliminate the potential threat of an encounter with MEC to the public (i.e. off-path Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016). This UFP-QAPP is supported by following existing and approved plans:

- *Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas* (Bhate Environmental Associates, Inc. [Bhate] 2019).
- *Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant*, Bhate, May 2018.
- *Explosives Safety Submission Performance-Based Remediation (PBR) LHAAP-17 Longhorn Army Ammunition Plant Karnack, Texas*, December 2020.
- *Final LHAAP-17 MEC Action Memorandum for Time Critical Removal Action, Longhorn Army Ammunition Plan, Karnack, Texas, September 2021.*

Table ES-1 provides a UFP-QAPP component crosswalk table that shows the Optimized UFP-QAPP Worksheets; their applicable 2106-G-05 Guidance Section, UFP-QAPP Manual Section, and EM 200-1-15 section; and an indication of applicability of the worksheet to MEC or MC.

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Table ES-1. UFP-QAPP Component Crosswalk Table

Optimized UFP-QAPP Worksheets		2106-G-05 UFP-QAPP Guidance Section		EM 200-1-15 Section	Applicability	
					MEC	MC
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off	Not Applicable (NA)	×	×
3 & 5	Project Organization and UFP-QAPP Distribution	2.2.3	Distribution List	2.1, 2.2	×	×
		2.2.4	Project Organization and Schedule	2.1, 2.2	×	×
4, 7 & 8	Personnel Qualifications and Sign-Off Sheet	2.2.1	Title, Version, and Approval/Sign-Off	2.1.4, 6.2.2.1, 8.2.5.1	×	×
		2.2.7	Special Training Requirements and Certification	2.1.4, 6.2.2.1, 8.2.5.1	×	×
6	Communication Pathways	2.2.4	Project Organization and Schedule	2.1, 2.2	×	×
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data	2.2	×	×
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data	2.2.3.1, 12.2	×	×
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria	2.2.3.2, 5.3, 9.2, 11.3	×	×
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria	5.3.7, 11.3, Tables 11-3 through 11-6	×	×
13	Secondary Data Uses and Limitations	Chapter 3	UFP-QAPP Elements for Evaluating Existing Data	NA	×	×
14 & 16	Project Tasks and Schedule	2.2.4	Project Organization and Schedule	2.1, 2.2	×	×
15	Screening Criteria and Laboratory-Specific Detection/Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria	7, 8.2.4.6, 8.2.6.9		×
17	Investigation Design and Project Work Flow	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks	8.2.4, 8.3.2, 8.5, 8.6, 8.7	×	×
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks	8.8		×
		2.3.2	Sampling Procedures and Requirements	8.8	×	×

Table ES-1. UFP-QAPP Component Crosswalk Table

Optimized UFP-QAPP Worksheets		**2106-G-05 UFP-QAPP Guidance Section**		**EM 200-1-15 Section**	**Applicability**	
					MEC	**MC**
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements	7.5.4, 7.5.5, 7.5.6, 7.6.9, 7.7.3, 7.8.9		×
20	Field Quality Control	2.3.5	Quality Control Requirements	11	×	×
21	Field Standard Operating Procedures	2.3.2	Sampling Procedures and Requirements	4.4.4, 8.8.1-8.8.4	×	×
22	Equipment Testing, Inspection, and Quality Control	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	6.7.2, 7	×	×
23	Analytical Standard Operating Procedures	2.3.4	Analytical Methods Requirements and Task Description	7.5.4, 7.5.5, 7.5.6, 7.6.9, 7.7.3, 7.8.9	×	×
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	7	×	×
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	NA	×	×
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation	NA		×
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements	11		×
29	Data Management, Project Documents and Records	2.2.8	Documentation and Records Requirements	13	×	×
31, 32 & 33	Assessments and Control Action	2.4	Assessments and Data Review (Check)	4.3, Appendix B	×	×
		2.5.5	Reports to Management	4.3, Appendix B	×	×
34	Data Verification, Validation, and Usability Inputs	2.5.1	Data Verification and Validation Targets and Methods	8.2.4.7, 8.8.8	×	×
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods	8.2.4.7, 8.8.8	×	×
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods	8.8.8	×	×

Table ES-1. UFP-QAPP Component Crosswalk Table

Optimized UFP-QAPP Worksheets		2106-G-05 UFP-QAPP Guidance Section		EM 200-1-15 Section	Applicability	
					MEC	MC
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability	8.8.8	×	×
		2.5.3	Potential Limitations on Data Interpretation	8.8.8	×	×
		2.5.4	Reconciliation with Project Requirements	8.8.8	×	×

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UFP-QAPP Worksheets #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information

- **Site Name/Project Name:** LHAAP-17/Time Critical Removal Action for Munitions and Explosives of Concern (MEC)
- **Site Location/Number:** LHAAP, Texas/LHAAP-17, Burning Ground No. 2/Flashing Area Group 2/EPA Identification Number TX6213820529
- **Lead Organization:** U.S. Army
- **Contractor:** MMG-TLI JV
- **Contract/Work Assignment Number:** W9128F18D0001/Task Order (TO) W912BV20F0207
- **Regulatory Program:** CERCLA

2. Plans and Reports from Previous Investigations Relevant to this Project:

Final Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant Karnack, Texas. Shaw Environmental, Inc. (Shaw), 2016.	August 2016
Draft Final Summary Report – Excavation and Backfill Activities at LHAAP-17 Longhorn Army Ammunition Plant, Karnack, Texas. Bhate, 2021.	March 2021
Final Remedial Design and Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas. Bhate-APTIM, 2019.	March 2019

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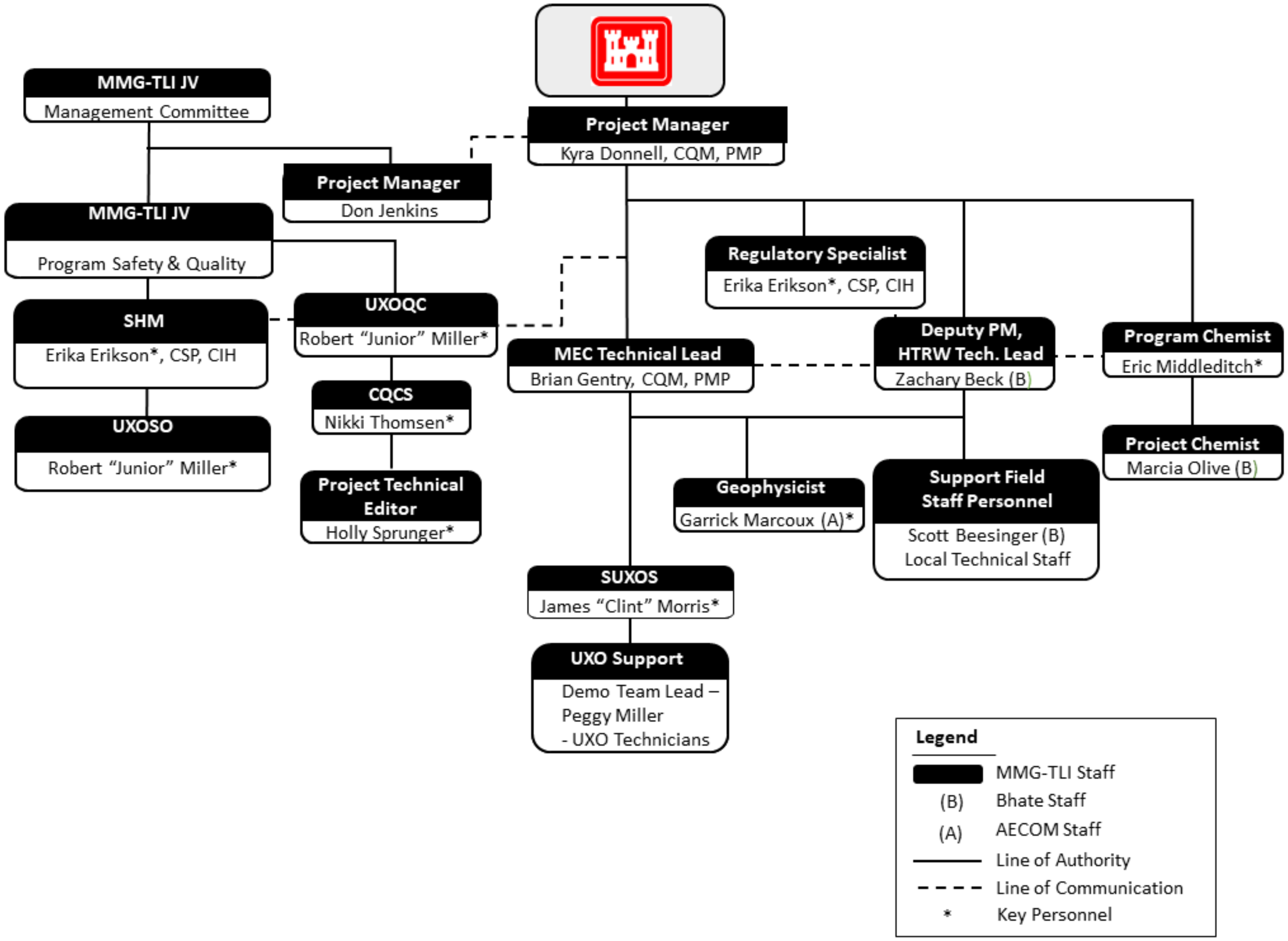
UFP-QAPP Worksheets #3 & 5: Project Organization and Quality Assurance Project Plan Distribution (UFP-QAPP Manual Section 2.3 and 2.4) (EPA 2106-G-05 Section 2.2.3 and 2.2.4)



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UFP-QAPP Worksheets #4, 7, & 8: Personnel Qualifications and Sign-Off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

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

Organization: MMG-TLI JV

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training/ Required Licenses/ Certifications/ Licenses/Authorizations	Signature/Date
Don Jenkins don.jenkins@mmg-us.com	Program Manager	Master of Business Administration (MBA) and Bachelor of Science (BS) degrees related to Program Management and is a graduate of Naval School EOD Over 10 years of experience in Program Management and over 14 years of working experience in environmental remediation services	Master EOD Technician	05/07/2021

Organization: MMG-TLI JV

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training/ Required Licenses/ Certifications/ Licenses/Authorizations	Signature/Date
Nikki Thomsen nikki.thomsen@techlawinc.com	CQCS	– BS, Natural Resources Management, Grand Valley State University, 2002 – Quality Assurance Director (QAD), TechLaw Consultants, Inc., January 2021 – QAD, TechLaw, 2018 to 2021 – Quality Assurance Officer (QAO), Regional Oversight Contracts (ROCs) Regions 2, 4/5, and 9/10, 2015 to 2021 – QAO on-site designee, Environmental Services Assistance Team (ESAT) Region 8, 2011 to 2021 – 18 years of environmental science experience	– Construction Quality Management (CQM) for Contractors, SE9-04-20-00391, June 2020 – Member of American Society of Quality (ASQ) since December 2020, including numerous QA-related webinars and training courses	05/07/2021

Organization: MMG-TLI JV

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training/ Required Licenses/ Certifications/ Licenses/Authorizations	Signature/Date
Kyra Donnell kyra.donnell@tlisolutions.com	PM	– BS, Civil Engineering, University of Tennessee, 1987 – Senior Regulatory Specialist with experience and expertise in CERCLA, Resource Conservation and Recovery Act (RCRA), National Environmental Policy Act (NEPA), Clean Water Act (CWA), and Clean Air Act (CAA), and knowledge of TX regulations – 27 years' experience in Project Management for projects that involve Hazardous, Toxic and Radioactive Waste (HTRW) – 19 years' experience in Project Management for projects that involve MEC	– Project Management Professional (2019) - Construction Quality Management (CQM) Certification (2016)	Kyra Donnell 05/07/2021

Organization: MMG-TLI JV

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training/ Required Licenses/ Certifications/ Licenses/Authorizations	Signature/Date
Brian Gentry brian.gentry@tlisolutions.com	MEC Technical Lead	– Naval EOD School graduate – 23 years of combined EOD/UXO experience – 13 years managing MR actions on MEC-contaminated sites – Project Management Professional, 2016, renewed in 2019 – Meets all requirements outlined in Table 4.1 of Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18	– USACE CQM for Contractors, 2016 – Meets all requirements outlined in Table 4.1 of DDESB TP-18	05/07/2021
Eric Middleditch eric.middleditch@techlawinc.com	Program Chemist	– BS, Chemistry, University of Northern Colorado, 2006 – Over 10 years of chemist experience for MEC investigations – Three years of environmental laboratory experience for DoD projects	– Meets all requirements outlined in Section 8 of Department of Defense (DoD) Policy and Guidelines for Acquisitions Involving Environmental Sampling or Testing (DoD 2007)	Eric Middle 05/07/2021
Robert “Junior” Miller	UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (UXO QCS)	– Over 25- years of combined EOD/MEC experience – Over -13 years of MEC supervisory experience	– Meets all requirements outlined in Table 4.1 of DDESB TP-18	05/07/2021

Organization: MMG-TLI JV

Name/ Contact Information	Project Title/Role	Education/Experience	Specialized Training/ Required Licenses/ Certifications/ Licenses/Authorizations	Signature/Date
James "Clint" Morris james.morrix@tlisolutions.com	Senior UXO Supervisor (SUXOS)	– Over 13 years of combined EOD/MEC experience – Over 5 years of MEC supervisory experience	– Meets all requirements outlined in Table 4.1 in DDESB TP-18	James C Morris 05/07/2021

Organization: AECOM

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Garrick Marcoux Garrick.marcoux@aecom.com	Program Geophysicist	– BS Geology, Western Washington University, 1996 – MS Hydrology, University of New Hampshire, 1998 – 22 years of geophysics experience; 16 years of MR geophysics experience – 40-Hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER), 2000 – 8-Hour OSHA HAZWOPER Refresher, May 2020	– 40-Hour OSHA HAZWOPER – 8-Hour OSHA HAZWOPER Refresher, Current – OSHA Physical, Current – Environmental Security Technology Certification Program (ESTCP) Geosoft UX-Analyze Training – Visual Sampling Plan (VSP) Training	Garrick Marcoux 05/07/2021

Organization: AECOM

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Sara McNamara sara.mcnamara@aecom.com	Project Geophysicist	– BS Geosciences, University of Arizona, 2002 – MS Geophysics, New Mexico Institute of Mining and Technology, 2004 – 13 years of MR geophysics experience – 40-Hour OSHA HAZWOPER, 2009 – 8-Hour OSHA HAZWOPER Refresher, September 2020	– 40-Hour OSHA HAZWOPER – 8-Hour OSHA HAZWOPER Refresher, Current – OSHA Physical, Current – Geosoft UX-Analyze Training – VSP Training	05/07/2021
Harry Wagner harry.wagner@aecom.com	QC Geophysicist	– BS Geophysical Engineering, Colorado School of Mines, 1997 – UXO Tech II, Texas A&M, 2008 – 21 years of experience – 40-Hour OSHA HAZWOPER, 2000 – 8-Hour OSHA HAZWOPER Refresher, April 2020	– 40-Hour OSHA HAZWOPER – 8-Hour OSHA HAZWOPER Refresher, Current – OSHA Physical, Current – ESTCP Geosoft UX-Analyze Training – VSP Training	Harry Wagner 05/07/2021

Organization: Bhate Environmental, Inc.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Zachary Beck zbeck@bhate.com	HTRW Technical Lead	– Bachelor of Science, Geology – (2000), Colorado State University – 20 years of experience as an Environmental Project/Task Manager with extensive experience managing environmental projects at the field operational level	– Professional Geologist (PG), Tennessee and Louisiana	8/23/21
Marcia Olive molive@bhate.com	Project Chemist	– Bachelor of Science, Chemistry (1995), – University of Colorado, Colorado Springs – 21 years of experience on Department of Defense (DoD) (U.S. Army, USACE, U.S. Navy, U.S. Air Force), Department of Energy (DoE), and Superfund projects as a Project Chemist		**8/23/21**

Organization: SGS North America, Inc. – Orlando

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Jean Dent-Smith jean.dent-smith@sgs.com	Laboratory Subcontractor PM	– B.A. Marine Biology 25+ years exp. in Environmental Laboratory Services	NA	Not required

Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date**
Sonia West Sonia.west@alsglobal.com	Laboratory Subcontractor PM	– 14 years of project management experience for Environmental Laboratory Services	NA	Not required

UFP-QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
Regulatory agency interface	BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110	TCEQ Superfund Program Project Manager April Palmie april.palmie@tceq.texas.gov (512) 239-4152 EPA Region 6 Remedial Project Manager Arkansas/Texas Section (SEDRA) Superfund Division Brian Follin follin.brian@epa.gov 214 665-7409	LHAAP provides monthly project updates to regulatory agencies via scheduled meetings and weekly email or telephonic communications during field operations.
Public interface	BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110	Public	LHAAP provides information to the public via the existing Restoration Advisory Board (RAB) meetings

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
Field activity/progress	MMG-TLI JV PM, Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502	USACE TM Aaron Williams aaron.k.williams@usace.army.mil (918) 669-4915 USAEC ERM Andrew Maly andrew.r.maly.civ@mail.mil (210) 466-1350 BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110	MMG-TLI JV communicates and documents field activities and progress through SUXOS Daily Reports. These reports are compiled into weekly reports for submission via email.

Stop work due to safety or quality issue	All personnel MMG-TLI JV, SUXOS James “Clint Morris James.Morris@tlisolutions.com (479) 461-2319	MMG-TLI JV, SUXOS Clint Morris James.Morris@tlisolutions.com (479) 461-2319 MMG-TLI JV, UXOSO/UXOQCS Robert “Junior” Miller Robert.Miller@tlisolutions.com (903)227-9954 MMG-TLI JV, MEC Technical Lead Brian Gentry brian.gentry@tlisolutions.com (865) 206-6290 MMG-TLI JV PM, Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502 MMG-TLI JV, CQCS Nikki Thomsen nikki.thomsen@techlawinc.com (571) 386-7595 USACE TM Aaron Williams aaron.k.williams@usace.army.mil (918) 669-4915 BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110 USACE OESS	***All personnel have the authority to temporarily stop field work for quality or safety issues.*** Personnel orally report their observations to either the SUXOS or UXOSO/UXOQCS. The SUXOS is ultimately responsible for assessing the situation and defining the parameters (e.g., duration, location, personnel) of the stop work order, issuing the order, and reinstating normal operations. The SUXOs communicates the circumstances of the stop work order as soon as possible (i.e., no later than 24 hours after the issue is identified) with the MR Operations Manager, TLI PM, and QCM via email and/or telephone. The TLI PM (or designee) communicates the circumstances of the stop work order and the proposed Corrective Action (CA) as soon as possible (i.e., no later than 24 hours after issue is identified) with the USACE TM, USAEC ERM, BRAC Site Manager, and USACE OESS via email. Stop work orders are documented in SUXOS Daily Report and weekly reports and summarized in the Remedial Action Completion Report (RACR).

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
		Michael Slavens michael.r.slavens@usace.army.mil (817) 456-6699	
Field changes	MMG-TLI JV, UXOSO/UXOQCS Robert "Junior" Miller Robert.Miller@tlisolutions.com (903)227-9954 AECOM, Project Geophysicist Sara McNamara sara.mcnamara@aecom.com (808) 990-6035 Bhate, Field Technican Scott Beesinger sbeesinger@bhate.com (903)930.6193	MMG-TLI JV, MEC Technical Lead Brian Gentry brian.gentry@tlisolutions.com (865) 206-6290 Bhate, HTRW Technical Lead Zachary Beck zbeck@bhate.com (720) 463-3907 MMG-TLI JV PM, Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502 MMG-TLI JV, CQCS Nikki Thomsen nikki.thomsen@techlawinc.com (571) 386-7595	The UXOSO/UXOQCS identifies necessary or recommended field changes related to MEC operations, and the Project Geophysicist identifies necessary or recommended field changes related to geophysical surveying as soon as possible (i.e., no later than 24 hours after the change is identified) to the MR Operations Manager, MMG-TLI JV PM, and CQCS via email and/or telephone. The MMG-TLI JV PM (or designee) assesses the change and generates a Field Change Request (FCR) (using a FCR form) as soon as possible (i.e., no later than 24 hours after accepting the change). For field changes that require a subsequent UFP-QAPP amendment, see UFP-QAPP amendments below.

UFP-QAPP amendment Note UFP-QAPP amendments will be restricted to substantial changes (as determined through discussions with TCEQ/EPA). Less substantial changes will be recorded in the report as minor deviations.	MMG-TLI JV PM, Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502	USACE TM Aaron Williams aaron.k.williams@usace.army.mil (918) 669-4915 BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110 USAEC ERM Andrew Maly andrew.r.maly.civ@mail.mil (210) 466-1350 TCEQ Superfund Program Project Manager April Palmie april.palmie@tceq.texas.gov (512) 239-4152 EPA Region 6 Brian Follin follin.brian@epa.gov 214 665-7409 MMG-TLI JV, CQCS Nikki Thomsen nikki.thomsen@techlawinc.com (571) 386-7595 USACE OESS Michael Slavens michael.r.slavens@usace.army.mil (817) 456-6699 USACE Chemist	The MMG-TLI JV PM (or designee) identifies any proposed amendments to the TCEQ/EPA-accepted UFP-QAPP as soon as possible (i.e., no later than 24 hours after proposed amendment is identified) with the USACE TM, USAEC ERM, and BRAC Site Manager via email or telephonic communication. The BRAC Site Manager identifies any USACE-accepted amendments to the TCEQ/EPA-accepted UFP-QAPP as soon as possible (i.e., no later than 24 hours after proposed amendment is accepted by the USACE TM and USAEC ERM) with the TCEQ and EPA via email or telephonic communication. For UFP-QAPP amendments prior to field work, MMG-TLI JV documents the proposed amendment (with concurrence by the USACE TM, USAEC ERM, and BRAC Site Manager) in a letter request submitted via email to TCEQ and EPA. For UFP-QAPP amendments during field work, MMG-TLI JV documents the proposed amendment (with concurrence by the USACE TM, USAEC ERM, and BRAC Site Manager on a FCR

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
		TBD*	form submitted via email to TCEQ and EPA. TCEQ and EPA document acceptance or non-concurrence of any proposed amendment to the TCEQ/EPA-accepted UFP-QAPP (within 72 hours prior to field work and within 24 hours during field work) via email to the BRAC Site Manager and USACE TM. MMG-TLI JV documents TCEQ and EPA acceptance of a proposed amendment to the TCEQ/EPA-accepted UFP-QAPP via a Change Control Log to be located at the front of the UFP-QAPP.

Non-conformance	MMG-TLI JV, UXOSO/UXOQCS Robert “Junior” Miller Robert.Miller@tlisolutions.com (903)227-9954 MMG-TLI JV, CQCS Bhate, Field Technican Scott Beesinger sbeesinger@bhate.com (903)930.6193 Nikki Thomsen nikki.thomsen@techlawconsultants.com (571) 386-7595 AECOM, Project Geophysicist Sara McNamara sara.mcnamara@aecom.com (808) 990-6035 USACE TM Aaron Williams aaron.k.williams@usace.army.mil (918) 669-4915 USACE OESS Michael Slavens michael.r.slavens@usace.army.mil (817) 456-6699	MEC Technical Lead, Brian Gentry brian.gentry@tlisolutions.com (865) 206-6290 Bhate, HTRW Technical Lead Zachary Beck zbeck@bhate.com (720) 463-3907 MMG-TLI JV Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502 Nikki Thomsen, CQCS nikki.thomsen@techlawinc.com (571) 386-7595 Program Manager, Don Jenkins don.jenkins@mmg-us.com (865) 686-8972 BRAC Site Manager Rose Zeiler Rose.Zeiler@calibresys.com (479) 635-0110 USACE TM Aaron Williams aaron.k.williams@usace.army.mil (918) 669-4915 USAEC ERM Andrew Maly andrew.r.maly.civ@mail.mil (210) 466-1350	Any number of individuals may identify a non-conformance issue (e.g., activity not performed in accordance with the UFP-QAPP or contractual performance metrics, or when results are not within a specified tolerance) as a result of field observations, audits, or inspection. The non-conformance issue will be communicated through management and quality channels via a Non-Conformance and Corrective Action Report (NCAR) as soon as possible (i.e., no later than 24 hours after identification of the non-conformance issue) transmitted via email. NCARs will be tracked on an NCAR log, and NCARs will be summarized in the RACR. Upon being made aware of a non-conformance issue, the MMG-TLI JV PM will direct a root cause analysis (RCA) and development of CAs (documented on the NCAR). Work practices and acceptable tolerances may be adjusted based on the outcome of the RCA process. Such adjustments will be captured in a field change (see field change communication process above) and may result in a UFP-QAPP amendment (see UFP-QAPP amendment process above).

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
		USACE OESS Michael Slavens michael.r.slavens@usace.army.mil (817) 456-6699 USACE Technical Manager (Chemist) Frank Roepke frank.roepke@usace.army.mil (918) 669-7444	
Sample shipment and/or laboratory QC variances	SGS North America, Inc. – Orlando (SGS) Primary Laboratory Jean Dent-Smith, PM Jean.Dent-Smith@sgs.com (407) 425-6700 x 32811 ALS Environmental (ALS) Secondary Laboratory PM Sonia West Sonia.West@ALSGlobal.com (281) 575-2132	Program Chemist, Eric Middleditch eric.middleditch@techlawinc.com (312) 550-8504	The laboratory-assigned PM will contact the MMG-TLI JV Program Chemist immediately (within one business day) via telephone or email to report any issues related to sample or analytical quality to discuss and identify CAs, if any. The Program Chemist will subsequently document the issue and any CAs and communicate these to the MMG-TLI JV PM via email for approval. QC issues will be documented by the Laboratory as part of the Laboratory data package and will be summarized and included in the final report.

Communication Driver	Initiator (name, project title)	Recipient (name and project title)	Procedure (Timing, Pathway, Documentation, etc.)
Electronic Data Deliverable (EDD) ready for download	SGS Primary Laboratory Jean Dent-Smith, PM Jean.Dent-Smith@sgs.com (407) 425-6700 x 32811 ALS Secondary Laboratory PM Sonia West Sonia.West@ALSGlobal.com (281) 575-2132	Program Chemist, Eric Middleditch eric.middleditch@techlawinc.com (312) 550-8504	The laboratory-assigned PM will contact the MMG-TLI JV Program Chemist immediately (within one business day) via email when the EDD is ready for download. The Program Chemist will notify the MMG-TLI JV PM via email and will direct the download and validation of the data.
Data validation issues	Program Chemist, Eric Middleditch eric.middleditch@techlawinc.com (312) 550-8504 Program Chemist	SGS Primary Laboratory Jean Dent-Smith, PM Jean.Dent-Smith@sgs.com (407) 425-6700 x32811 ALS Secondary Laboratory PM Sonia West Sonia.West@ALSGlobal.com (281) 575-2132 MMG-TLI JV PM, Kyra Donnell kyra.donnell@tlisolutions.com (865) 607-0502 Nikki Thomsen, CQCS nikki.thomsen@techlawinc.com (571) 386-7595 USACE Chemist TBD*	The Program Chemist will, as needed, discuss and resolve validation issues with the Laboratory. The Program Chemist will notify the CQCS and PM when data validation issues are identified that may result in rejected data. The Program Chemist will apply data validation qualifiers when appropriate. Data validation will be discussed in the final report.

* TBD will be identified in the Final UFP-QAPP.

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UFP-QAPP Worksheet #9: Project Planning Session Summary
(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

9.1 Technical Project Planning (TPP) Meeting No. 1

Date: To Be Determined. Meeting minutes from any future planning sessions will be presented here.

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UFP-QAPP Worksheet #10: Conceptual Site Model
(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)
(MR-QAPP Module 1: RI/FS Revision Number: Final Revision Date: December 2018)

This worksheet presents the information that supports the Conceptual Site Models (CSMs) for MEC and MC at the LHAAP-17 Burning Ground No. 2/Flashing Area. Worksheet 10 was developed using information presented in the final ROD (Shaw, 2016). The graphical CSMs are presented in **Figure 10-1** (MC CSM for human receptors), **Figure 10-2** (MC CSM for ecological receptors), and **Figure 10-3** (MEC CSM).

10.1 Background Information

The former LHAAP is an inactive, government-owned, formerly contractor operated and maintained, DoD facility located in central east Texas (see **Figure ES-1**) in the northeast corner of Harrison County. LHAAP is approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles west of Shreveport, Louisiana. The former Army installation occupied 8,416 acres between State Highway 43 at Karnack, Texas and the southwestern shore of Caddo Lake.

LHAAP was established in December 1941 with the primary mission of manufacturing TNT. Production of TNT began at Plant 1 in October 1942 and continued through World War II until August 1945, when the facility was placed on standby status until February 1952. In 1952, the LHAAP facility was reactivated with the opening of Plant 2, where pyrotechnic ammunition, such as photoflash bombs, simulators, hand signals, and tracers for 40 mm ammunition, were produced until 1956. In December 1954, a third facility, Plant 3, began production of solid-fuel rocket motors for tactical missiles. Rocket motor production at Plant 3 continued to be the primary operation at LHAAP until 1965 when Plant 2 was reactivated for the production of pyrotechnic and illuminating ammunition. In the years following the Vietnam conflict, LHAAP continued to produce flares and other basic pyrotechnic or illuminating items for the U.S. Department of Defense inventory. From September 1988 to May 1991, LHAAP was also used for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force Treaty in effect between the United States and the former Union of Soviet Socialist Republics. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

LHAAP was placed on the Superfund NPL on August 9, 1990. Activities to remediate contamination began in 1990. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property. The majority of LHAAP has been transferred by the Army to the USFWS for management as the Caddo Lake National Wildlife Refuge.

10.1.1 LHAAP-17 Site Description

LHAAP-17, known as the Burning Ground No. 2/Flashing Area, is a 3.9-acre site located within a heavily wooded section in the southeastern portion of LHAAP (**Figure ES-3**). LHAAP-17 was used as a burning ground from 1959 through 1980. Bulk TNT, photo flash powder, and reject material from Universal Match Corporation operations were burned at LHAAP-17. In 1959, the materials removed from the former TNT Production Area (LHAAP-29) and the former TNT Waste Disposal Plant (LHAAP-32) during demolition were burned and/or flashed at LHAAP-17. The site was used as a flashing area to decontaminate recoverable metal byproducts until 1980, when it became inactive. Burning trenches were located around the inside perimeter of the previously fenced area and within the open area on the western boundary of the site. As each trench filled with ash, it was covered, and a new trench was dug. The waste residues were reportedly removed from the trenches in 1984, and the site was allowed to revegetate.

LHAAP-17 has two 185 ft-by-305 ft cleared areas, separated by a gravel access road and contains 13 excavation areas (Areas A, B, C, D, E, F, G, H, J, K, L, M and N) (**Figure ES-3**). The site is covered with grass and scattered brush, has been graded above the surrounding terrain, and is relatively flat, except for the excavated areas, berms, and existing soil stockpiles. A separate cleared area measuring approximately 300 ft by 200 ft divided by a partially graveled haul road, is present north of LHAAP-17.

Groundwater contamination is present at LHAAP within the shallow and intermediate zones. Shallow groundwater COCs are perchlorate and volatile organic compounds (VOCs) including 1,2-dichloroethane [DCA], 1,1-dichloroethene [DCE], cis-1,2-DCE, trichloroethene [TCE], and vinyl chloride [VC]). Intermediate zone groundwater COCs are TCE and its daughter products (DCE and vinyl chloride). The shallow groundwater perchlorate plume, which largely encloses the VOCs plumes, has a lateral extent of approximately 160,000 square feet, and a vertical extent of approximately 15 ft. An existing groundwater monitoring well network comprised of monitoring wells completed within the shallow and intermediate zone is shown on **Figure 10-4**. Groundwater concentrations and the estimated perchlorate plume extent are included in Appendix J (see Table 5-1 and Figure 5-1, respectively).

Surface drainage flows to ditches along the eastern and western boundaries of the site and then to Harrison Bayou, which is located to the west of LHAAP-17. The entire site is within the 100-year floodplain of the bayou.

10.1.2 Regulatory Authority

Due to the releases of chemicals from facility operations, the EPA placed LHAAP on the Superfund NPL on August 9, 1990. After the listing on the NPL, the Army, EPA, and TCEQ entered into a CERCLA §120 Federal Facility Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP-17 was one of the originally listed NPL sites in the FFA. The Feasibility Study (FS) for LHAAP-17 was issued in April 2010, the Proposed Plan was issued in May 2010, and the ROD was finalized in August 2016.

The TCRA performed under this TO will be conducted IAW CERCLA and all applicable Federal, State, and local laws and regulations and USACE Engineering Manual (EM) 200-1-15 (USACE, 2018). Because CERCLA has no special provisions related to explosives safety, the provisions of *Defense Explosive Safety Regulation (DESR) 6055.09* (DoD, 2019) and USACE EM 385-1-97 will be adhered to.

The environmental sites at LHAAP are managed by BRAC and funded under the Defense Environmental Restoration Authority. The Army is the lead agency for LHAAP. The EPA Region 6 and the TCEQ are the regulatory agencies providing technical support, project review and comment, and oversight of the LHAAP cleanup program. The EPA is the lead oversight agency for NPL sites and the TCEQ is the lead oversight agency for non-NPL sites. LHAAP-17 is an NPL site.

10.1.3 Previous Investigations

As part of the Installation Restoration Program, the U.S. Army began an environmental investigation in 1976. Several investigations to determine the nature and extent of contamination in the soil, groundwater, surface water, and sediments at LHAAP-17 have been completed and are listed below. Samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), metals, explosive compounds, perchlorate, pesticides, polychlorinated biphenyls (PCBs), and/or dioxins/furans, depending on the focus of the investigation. For some of the earlier investigations, LHAAP sites were organized into groups, and LHAAP-17 was included in Group 2. The group designation was deemphasized as the complexities of the individual sites became greater. The following summarizes the investigations at LHAAP-17:

- **Multi-phase investigation of Group 2 sites**: Between 1982 and 1998 numerous investigations were conducted in a phased approach. Activities included installation of monitoring wells and analysis of groundwater, surface water, soil, and sediment samples. Sample locations at LHAAP-17 for soil and surface water/sediment and well locations for the shallow and intermediate groundwater zones are provided in the ROD.
- **Plant-wide perchlorate investigation**: This groundwater investigation was conducted from 2000 through 2002.
- **Baseline Human Health Risk Assessment**: The Baseline Human Health Risk Assessment (BHHRA) used data from the investigations conducted through 2001, including the plant-wide perchlorate investigation results up to that time. The report concluded that the soil and groundwater at LHAAP-17 both posed unacceptable carcinogenic risk and noncarcinogenic hazard to the hypothetical future maintenance worker.
- **Environmental Site Assessment**: Media investigated in 2003 included soil and groundwater, although no sampling was conducted at LHAAP-17 for this assessment.
- **Perchlorate treatability demonstration**: This study was conducted in 2003 and 2004 to demonstrate that perchlorate concentrations in soil can be reduced by soil composting. Organic amendments were added to a 1-acre area in the western portion of LHAAP-17, where the highest concentrations of perchlorate-contaminated soil were located. Decreased concentrations for perchlorate and explosive compounds were observed in the soil, as well as for perchlorate in groundwater.
- **Baseline Ecological Risk Assessment**: The Baseline Ecological Risk Assessment (BERA) identified constituents of ecological concern (COECs) for the Waste Sub-Area, which includes LHAAP-17. COECs for the subarea are addressed in the remedial actions for LHAAP-17. The evaluation was based on environmental investigations from 1993 to 2006.
- **Data gaps**: Additional investigations were conducted after the BHHRA was finalized to further delineate the extent of groundwater contamination identified during previous sampling events.
- **Pre-Design Investigation (PDI):** A PDI was conducted between November 2017 and March 2018 in accordance with the PDI Work Plan (AECOM 2016) to collect information required for the preparation of the RD/RAWP. This investigation included a soil investigation and aquifer pumping test.
- **Groundwater sampling June 2021**: Groundwater samples from a subset of monitoring wells were collected in June 2021 to confirm the current extent of the perchlorate plume in groundwater.

10.2 Sources of Known or Suspected Contaminants

The LHAAP-17 site was used for burning bulk TNT, photoflash powder, and reject material from Universal Match Corporation's production processes. The site was operated as a burning ground from 1959 until 1980 and consisted of four burning pits 5 ft deep and 10 ft wide.

Waste residues were removed in 1984 with evidence of bulk burial of TNT occurring prior to 1954 and the area was grassed over. VOCs and explosive compounds were found in the groundwater. Explosive compounds were found in the soil. Perchlorate was detected in groundwater and soil at this site in 2000. An RI was completed in 2002 and a FS was finalized in 2010. A Research and Development project for enhanced in-situ bioremediation (perchlorate in soil) was started in 2002 and completed in 2004 by PEC. The Final ROD was signed in September 2016 identifying the remedy as excavation of contaminated soil, extraction and treatment of groundwater, MNA and LUCs. A Pre-Design Investigation (PDI) Work Plan was finalized in November 2016 for resampling existing wells, installation of up to three new monitoring wells, additional soil sampling to refine extent of soil contamination, and conducting a shallow zone pumping test and results reported in the Draft Final PDI Report approved in September 2018. The Draft Final RD/RAWP was approved in March 2019.

Excavation activities began at LHAAP-17 in August of 2019 with a goal to remove soil contaminated with TNT, 2,4-DNT, 2,6-DNT, and perchlorate at levels exceeding human health criteria and transport the contaminated soil to a suitable landfill. On August 30, 2019, halfway through excavation work, Bhate uncovered a 4.2-inch mortar in Area M. Based on the history of the site, munitions were not expected to be found at LHAAP-17, and as a result, their hazards and disposal were not addressed in the excavation contract/task order. As a result, work was temporarily stopped while military EOD responded. EOD personnel identified the ordnance as an unfuzed 4.2-inch illumination mortar which appeared to be empty. However, the space inside the projectile could not be fully cleared of dirt, ash, and other debris to determine if all of the expelling charge had been consumed during past disposal attempts. EOD moved the round to a 2-ft deep trench opened by excavation activities and detonated a countercharge to clear the round. Based on the results of the shot, the EOD team determined that the mortar was empty. Based on EOD findings, it was believed that this was an anomaly for the site, and subsequently, Bhate was directed to continue work. On September 7, 2019 a second 4.2-inch mortar was unearthed by the excavator in Area N resulting in another work stoppage. EOD again responded to the site, and on examination, found that this second mortar projectile was completely empty. They removed it from the site. Excavation work resumed on Monday September 16, 2019 with an OESS on site to provide support in case further munitions were disclosed during soil removal. The OESS located and identified hundreds of munitions items within the excavation areas and was able to determine their condition without stopping work; however, he did locate MPPEH, which generated two more EOD responses. On Friday September 27, 2019 EOD was called out to dispose of two M301 81mm illuminating mortars that the OESS recovered from areas M and N, but he could not ascertain their explosive safety status due to a metal baffle closing the body cavity behind the fuze wells. EOD performed field radiography on both mortars and disposed of them by detonation in the open excavation in Area L. Based on their analysis, EOD reported that the two 81mm mortars contained live flares. On Saturday September 28, 2019, the OESS found one (1) live M19 series rifle-launched green parachute signal mixed in with debris from 134 other signals and flares found in the soil stockpile excavated from Area H, and nine (9) live artillery base tracer elements discovered in an accumulation of 124 tracer elements found in a soil stockpile set aside for transportation adjacent to Area K. As a result of these accumulated finds, all work was stopped at the site. All of this MEC was destroyed in a detonation on-site by EOD on September 30, 2019. The USACE ordered a work stoppage and no additional intrusive activity has been conducted until plans are developed to address potential MEC hazards.

No HE munitions were recovered during the excavation in LHAAP-17, only pyrotechnic munitions were found and subsequently destroyed during the OESS's assignment to the site. Non-munitions related debris (NMRD) excavated from the site included scrap plate and structural steel, plumbing stock, pumps, motors, fence poles, clamps, and barbed wire outriggers, electrical wiring, and a large concentration of copper wire that had been discarded from a lightning protection system on one of the old structures. During the two weeks of OESS on-site support, the OESS uncovered and collected approximately 1200 pounds of MD. At the time of the stop work order from the CO, approximately 1,800 CY of excavated soil had been stockpiled on site at LHAAP-17 awaiting transportation to the landfill. Based on the large quantity of MD and live munitions recovered at LHAAP-17 by the OESS during on-site support, it is deemed possible that MPPEH remains in the excavated soil piles.

During the execution of the soil remediation at LHAAP-17, the contractor implementing the remedy encountered MEC and munitions debris. The MEC encountered included two M301 81-mm illumination mortars, nine artillery base tracer elements, and one M19 series rifle-launched green parachute signal. Two 4.2-inch illumination mortars empty of energetic fill material were also recovered. It is now suspected that previously unidentified MEC is serving as a primary source of perchlorate for soil and groundwater contamination at LHAAP-17. Perchlorates are commonly used in a variety of munitions items including illumination rounds, flares, fuses, and simulators.

10.3 Nature and Extent of Contamination

Several sampling events were conducted at LHAAP-17 from 1982 to 2009 to characterize the nature and extent of contamination. In the early investigations, soil samples were collected from throughout the site to determine the areas of contamination. Subsequent investigations focused on the areas where contamination was found, performing additional soil, groundwater, and sediment sampling, and installing monitoring wells to delineate the contamination. Samples were analyzed for various analytes, including VOCs, SVOCs, metals, explosives, perchlorate, pesticides, and dioxins/furans. In the area of the contaminant plume, groundwater samples were also analyzed for indicators of conditions that promote natural attenuation (biodegradation), such as dissolved oxygen, conductance, pH, oxidation-reduction potential, sulfide, methane, and chloride.

VOC, explosive, and perchlorate compound releases resulting from the presence of MEC and the burning of explosive type materials removed from the TNT Production Area and the TNT Waste Disposal Plant are the suspected sources of contamination in soil and groundwater at LHAAP-17. Contamination at LHAAP-17 was found in both the soil and groundwater (shallow and intermediate zones). The COCs are toxic and carcinogenic, with the principal threat waste material found present in the contaminated soil. The COCs and COECs for LHAAP-17 for the various media are identified below:

- Soil COCs and COECs are explosives (2,4,6-TNT, 2,4-DNT, 2,6-DNT), dioxins (2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalence concentration [TEC]), perchlorate (potential soil COC based on groundwater concentrations), and barium
- Shallow zone groundwater COCs are perchlorate and VOCs (DCA, DCE, TCE, and VC)
- Intermediate zone groundwater COCs are TCE and its daughter products (DCE and vinyl chloride)

10.4 Primary Release Mechanism and Secondary Contaminant Migration

The primary MEC and MC release mechanisms were burning and disposal of munitions during operation of the LHAAP-17 site (1959-1980). The primary MEC exposure pathways for humans are direct contact with surface MEC and MC by the public (i.e., off-path Caddo Lake National Wildlife Refuge visitors and trespasses) and/or with subsurface MEC and MC by environmental construction workers during intrusive activities while carrying out the requirements of the LHAAP-17 ROD (Shaw, 2016).

10.5 Fate and Transport Considerations

LHAAP-17 is characterized by relatively flat topography, scattered brush, heavy woods, and graded terrain. Surface drainage flows to ditches along the eastern and western boundaries of the site and then to Harrison Bayou, which is located to the west. The predominant groundwater flow in the shallow and intermediate zones is generally to the northwest towards Harrison Bayou. The LHAAP-17 site is located within 100-year floodplain of the bayou; however, no surface water bodies are located on the site.

10.6 Potential Receptors and Exposure Pathways

LHAAP is surrounded by a fence (except on the border with Caddo Lake), and current security measures preclude unlimited public access to areas within the fence, except for extremely limited hunting. Future land use for the site involves being added to the Caddo Lake National Wildlife Refuge, which currently occupies approximately 7,000 acres of the 8,416-acre former LHAAP installation. Potential receptors include off-path Caddo Lake National Wildlife Refuge visitors and trespassers and environmental construction workers carrying out the requirements of the LHAAP-17 ROD, and ecological receptors.

Both direct and indirect (food chain pathways) were considered when analyzing potential receptor and exposure pathways with contaminants in site media (soil and groundwater). Receptors considered in the food chain evaluation included the following: Deer Mouse, Short-Tailed Shrew, Raccoon (modified Raccoon [as a surrogate for the Louisiana Black Bear]), Red Fox, Townsend’s Big-Eared Bat, Bank Swallow, Belted Kingfisher, American Woodcock, Red-Tailed Hawk, Aquatic Life (benthic invertebrates).

Two different soil depths were used for modeling exposure to ecological receptors: surface soil (0 to 0.5 ft) and total soil (0 to 3 ft). Each receptor was assumed to be exposed to one of the two depths based on its life history characteristics (e.g., burrowing animals were assumed to be exposed to total soil). Bioaccumulation of chemicals up the food chain was initially estimated using uptake factors obtained from available literature, and then refined using site-specific data obtained during the BERA.

10.7 Land Use Considerations

LHAAP is located near the unincorporated community of Karnack, Texas. Karnack is a rural community with a population of 775 people. The incorporated community of Uncertain, Texas, population 205, is located to the northeast of LHAAP on the edge of Caddo Lake and is a resort area and an access point to Caddo Lake. The industries in the surrounding area consist of agriculture, timber, oil and natural gas production, and recreation. LHAAP has been an industrial facility since 1942. The plant area has been relatively dormant since the facility was determined to be in excess of the U.S. Army’s needs in 1997.

LHAAP is surrounded by a fence (except on the border with Caddo Lake), and current security measures at the LHAAP preclude unlimited public access to areas within the fence. The fence now represents the National Wildlife Refuge boundary. Approved access for hunters is very limited. Access to LHAAP-17 within LHAAP is restricted in that the two gravel access roads are chained/gated. However, LHAAP-17 is accessible through the woods by off-path Refuge visitors and trespassers.

The anticipated future use of LHAAP-17 is as part of a national wildlife refuge. This anticipated future use is based on a Memorandum of Agreement (MOA) between the USFWS and the Army. That MOA documents the transfer process of the LHAAP acreage to USFWS to become the Caddo Lake National Wildlife Refuge and will be used to facilitate a future transfer of LHAAP-17. Presently, the Caddo Lake National Wildlife Refuge occupies approximately 7,200 acres of the 8,416-acre former installation. In accordance with the National Wildlife Refuge System Administration Act of 1966 and its amendments (16 USC 668dd), the land will remain as a national wildlife refuge unless there is a change brought about by an act of Congress, or the land is part of an exchange authorized by the Secretary of the Interior.

10.8 Key Physical Aspects of the Site

The LHAAP-17 site (approximately 3.9 acres in the southern portion of LHAAP) is covered with grass, scattered brush, and heavy woods. As part of the Floodplains and Low Terraces Ecoregion, LHAAP-17 lies within the 100-year floodplain of the Harrison Bayou, which is located to the west.

10.8.1 Topography

The topography at the LHAAP-17 site is relatively flat, mainly covered with grass, brush, and trees. There are two cleared areas that have been graded above the surrounding terrain, each 185 ft by 305 ft.

10.8.2 Climate and Vegetation

Mean annual temperatures range from 42-56 degrees Fahrenheit (°F) in the LHAAP area, with a range of about 34-93. The area is relatively wet with an average of 51 inches of rain a year.

Topographic, hydroperiod, and soil differences create a complex continuum of vegetation, complicated further by current and historical human impacts in the LHAAP ecoregion. In general, water oak (*Quercus nigra*), willow oak (*Q. phellos*), sweetgum (*Liquidambar styraciflua*), blackgum (*Nyssa sylvatica*), elm (*Ulmus* spp.), red maple (*Acer rubrum*), southern red oak (*Q. falcata*), swamp chestnut oak (*Q. michauxii*), and loblolly pine (*Pinus taeda*) are typical, along with holly (*Ilex* spp.), grape (*Vitis* spp.), poison ivy (*Toxicodendron radicans*), crossvine (*Bignonia capreolata*), greenbriar (*Smilax* spp.), and a variety of ferns and mosses. Baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) are found in semipermanently flooded areas, especially in sloughs, channels, and oxbows; Spanish moss (*Tillandsia usneoides*) hangs in these trees, and floating aquatic plants often occur. On wet flats, backswamps, and swamp margins that are seasonally flooded, overcup oak (*Q. lyrata*), water hickory (*Carya aquatica*), water elm (*Planera aquatica*), sweetgum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), and red maple (*Acer rubrum*) occur. Riverbanks may contain black willow (*Salix nigra*), sycamore (*Plantanus americana*), and eastern cottonwood (*Populus deltoides*).

10.8.3 Geology and Soils

The local geology at LHAAP-17 consists of silty, clayey and sandy units of the Wilcox Group. The uppermost unit consists predominantly of silty clay to clay extending to depths ranging from 5 to 30 ft. Underlying this layer is a gray to light brown, fine grained silty sandy unit interbedded with silty clay to clay lenses. The clay layers act as an aquitard separating the shallow zone from the intermediate zone. A thick, fine to medium grained sand layer was encountered in boring 17WW05 from 50 to 151 ft in depth without encountering the silty clay lenses. The sand layer was underlain by a dense, dark gray clayey shale.

10.8.4 Hydrogeology

The depth of the shallow groundwater zone generally ranges from 18 to 35 ft below ground surface (bgs). The intermediate zone is less defined, but its depth has been measured to approximately 55 ft bgs. The deep groundwater zone extends to a depth of approximately 151 ft bgs. The predominant groundwater flow in the shallow and intermediate zones is generally to the northwest towards Harrison Bayou. Based on historical groundwater flows, the direction can vary more to the west or more to the north.

10.8.5 Surface Water Hydrology

There are drainage ditches that run along the eastern, western and northern boundaries of the site that ultimately discharge to Harrison Bayou located approximately 1,500 feet to the northwest. Harrison Bayou discharges to Caddo Lake.

10.8.6 Ecological Resources

As part of the South Central Plains ecological zone, LHAAP is in the Floodplains and Low Terraces Ecoregion 35. This ecoregion is mostly defined by the Holocene alluvial floodplains and low terraces where there is a distinct vegetation change into bottomland oaks and gum forest. Overbank flooding, subsurface groundwater, and local precipitation recharge water levels in backswamps, pools, sloughs, oxbows, and depressions define this floodplain region. The bottomland forests in this ecoregion provide important wildlife habitat with a high diversity of species. One estimate of East Texas bottomlands fauna listed 119 fish, 36 amphibian, 59 reptile, 279 bird, and 48 mammal species.

There are no known Federal Endangered Species Act (ESA)-protected animal or plant species on LHAAP, however there are 22 animal species that could potentially be present on or near LHAAP that appear on federal or state Threatened & Endangered species lists. Although no longer protected under the Federal ESA, the bald eagle remains protected under the Federal Bald and Golden Eagle Protection Act and bald eagles are known or suspected to occur in the vicinity of LHAAP. No critical habitat exists at LHAAP.

10.8.7 Cultural Resources

There are no known cultural resources located within LHAAP-17 and none are anticipated to be impacted by the planned TCRA activities.

10.9 Munition and Explosives of Concern and Munitions Constituents Conceptual Site Models

Figure 10-1 illustrates the human health CSM for MC at LHAAP-17, while **Figure 10-2** illustrates the ecological CSM for MC at LHAAP-17. **Figure 10-3** illustrates the CSM for MEC at LHAAP-17.

UFP-QAPP Worksheet #11: Project/Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

DQO Steps and Description	DQO Step Activity
1) State the Problem *Define the problem that necessitates the study. Examine budget and schedule issues.*	• Based on the CSM, MEC (and associated MC [i.e., explosives constituents and/or perchlorate]) are potentially present in surface and subsurface soils within LHAAP-17 and may present a potential risk to the public (i.e. off-path Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016). In addition, blown-in-place (BIP) or consolidated shots used to dispose of potential MEC/material documented as an explosive hazard (MDEH) during the conduct of the TCRA may result in MC contamination to site soils.

2) Identify the Goals of the Data Collection
State how data will be used in meeting objectives and solving the problem.
	MEC
	• Principal study question: What is the type, density, and distribution (horizontal and vertical) of MEC within the surface and subsurface soils of LHAAP-17?
	• Alternative outcomes:
	  • Geophysical survey data, surface sweep results, subsurface removal results, and results of inspection of recovered materials from the sift operations indicates the presence, type, density, and distribution of MPPEH.
	  • Surface sweep, removal and inspection of subsurface anomalies to the depth of detection, and inspection of recovered materials from the sift operations indicates no evidence of MEC.
	• How the data will be used in solving the problem:
	  o Results of the surface sweep, removal and inspection of subsurface anomalies, and inspection of recovered materials from the sift operations will be used to determine the type and density of MEC at LHAAP017 and update the CSM. Their removal will reduce, mitigate or eliminate the potential threat of an encounter with MEC.
	Chemical Constituents
	• Principal study questions:
	  o Is MC (i.e., explosives and/or perchlorate) present in soil beneath and/or near recovered MEC and if so, at what concentrations?

DQO Steps and Description	**DQO Step Activity**
	o Is MC (i.e., explosives and/or perchlorate) present in soils at BIP and/or consolidated shot locations following detonation during the TCRA and if so, at what concentrations? • <u>Alternative outcomes</u>: o Concentrations are below screening criteria. o Concentrations are above screening criteria. • <u>How the data will be used in solving the problem:</u> o The results of soil sampling at recovered MEC locations will be used to identify contaminated soils that may be related to MEC and to determine the need for soil removal. o The results of post-detonation soil sampling will be used to determine the need for soil removal.
3) Identify Inputs to Decision *Identify data and information needed to make the study decision(s).*	• Historic use, types, and quantities of MEC found to date(Worksheet #10) • Geophysical detection survey results • Results of surface sweep and results of the removal and inspection of subsurface anomalies, which will provide information regarding the depths and types of munitions-related items • MEC disposal records associated with the TCRA • NCARs (including RCAs and CAs) and FCRs • Revised CSM • Soil sampling analytical and data validation results • Screening criteria for explosives constituents and perchlorate

DQO Steps and Description	DQO Step Activity
4) Define the Study Boundaries of the Project *Specify the target population and characteristics of interest. Define the spatial and temporal boundaries.*	**MEC** • Target population: The MEC target population for LHAAP-17 includes the public (i.e., off-path Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 ROD who may potentially be exposed to MEC that has migrated to the surface or has been uncovered due to human interaction, erosion, etc., and environmental construction workers carrying out the requirements of the LHAAP-17 ROD who may potentially be exposed to MEC in the subsurface. • The known munition for LHAAP-17 is the M301, 81mm projectile. See Table 11-1 below. • The expected detection threshold along within DGM grids will be determined via the IVS Letter Report. Targets in the grids will be above the detection threshold as documented in the target selection memo. **Chemical Constituents** • Target population: The MC target population for LHAAP-17 includes environmental construction workers, off-path refuge visitors, and trespassers and future hypothetical maintenance workers and trespassers exposed to surface soils and future hypothetical maintenance workers potentially exposed to surface and subsurface soil. **Figure ES-3** (Worksheet #10) identifies the prescribed boundaries of LHAAP-17.
5) Develop the Project Data Collection and Analysis Approach *Develop the parameter of interest, specify the type of interference, and develop the logic (decision rules) for drawing conclusions from the study findings.*	**MEC** Geophysical survey data, results of the surface sweep, results of the removal and inspection of subsurface target anomalies and inspection of recovered materials from the sift operations will be used to determine the type and density of MEC at LHAAP-17 and to update the CSM. Their removal will reduce, mitigate or eliminate the potential threat of an encounter with MEC. Parameters of interest: • For surface sweep: type, density, and distribution of MEC/MPPEH/MD • For DGM: location, number, and spatial distribution of anomalies with a millivolt (mV) response above the project-specific threshold identified through the IVS. The project-specific threshold will be a multiple of site noise (typically 5-7 times) determined during the initial IVS measurements. • For removal and inspection of subsurface anomalies: type, density, and distribution (horizontal and vertical) of MEC/MPPEH/MD

DQO Steps and Description	DQO Step Activity
	Decision rules: • Use DGM to evaluate the full-coverage grids. • If a grid anomaly meets the threshold for anomaly selection (i.e., target of interest), it will be removed (i.e., dug) and inspected to determine its nature. **Chemical Constituents** Parameters of interest: Concentrations of MC (i.e., explosives constituents and perchlorate) will be analyzed in site soils for the purpose of identifying contaminated soils at locations where MEC is recovered and to determine the need for soil removal. Concentrations of MC (i.e., explosives) will be analyzed in site soils for the purpose of determining the need for soil removal at locations where MEC detonations are performed (via BIP or consolidated shots). Decision Rules: • Validated analytical results of soil analyses will be screened against the cleanup levels presented in Table 1-2 and 1-3 of the RD/RAWP, LHAAP 17 (Bhate-APTIM, 2019). • If validated analytical results indicate concentrations of MC in soil (i.e., explosives constituents and perchlorate) are above applicable screening criteria, then soil removal will be required.
6) Specify Project-Specific MPC *Considering Steps 1-5, derive project-specific MPCs that collected data will need to achieve to minimize the possibility of making erroneous decisions. MPCs are the qualitative and quantitative specifications for accuracy, sensitivity, representativeness, completeness, and comparability that collected data must meet to satisfy the DQOs described in Steps 1-5 and are the criteria against which data usability will be evaluated at the end of the study.*	**MEC and Chemical Constituents** Project-specific Measurement Performance Criteria (MPC) are presented in Worksheet #12, and Laboratory-specific detection/quantitation limits are specified in Worksheet #15. Additional criteria to ensure analytical samples meet quality objectives are presented in Worksheets #18 (which identifies the EPA methods to be used), #28 (which presents the QC criteria and CAs), and #34 (which identifies the data verification and validation inputs). These are the criteria the collected data must meet to satisfy the DQOs. Failure to achieve these criteria may require re-work and may have an impact on the end use of the data.

DQO Steps and Description	DQO Step Activity
7) TCRA Design and Project Work Flow *Develop a resource-effective design for collecting data that will meet the project-specific MPCs developed during Step 6.*	The design of the TCRA is summarized below and detailed in Worksheet #17. The TCRA design is broken down into a series of specific processes and data collection steps, termed definable features of work (DFWs). The chemical constituent design is supported by Worksheets #19 & #30, #20, #24, #25, #26 & #27, and #28. **MEC** – The observations of material removed from excavations and through soils sifting combined with the results of the full coverage DGM grids and of the removal and inspection of individual subsurface anomalies will determine the type, density, and horizontal and vertical distribution of MEC within LHAAP-17. – The type, density, and distribution of MEC, MPPEH and MD within the LHAAP-17 will be used to update the CSM. **Chemical Constituents** • Discrete soil samples will be collected at locations where MEC/MPPEH is recovered to identify contaminated soils that may be related to MEC as the source of explosives constituents and perchlorate. Results will be screened against the cleanup levels presented in Table 1-2 and 1-3 of the RD/RAWP, LHAAP 17 (Bhate-APTIM, 2019) to determine the need for soils removal and to characterize for disposition as described in Worksheet #17. • Composite soil samples will be collected following the conduct of BIP or consolidated shots to evaluate the impact of these activities. These samples will be analyzed for explosives and perchlorate. Results will be screened against the cleanup levels presented in Table 1-2 and 1-3 of the RD/RAWP, LHAAP 17 (Bhate-APTIM, 2019). to determine the need for soils removal and to characterize for disposition, as described in Worksheet #17.

Table 11-1. Documented LHAAP-17 MEC

Known or Suspected Munitions Used (including nomenclature, if known)	Characteristics of Interest					
	MEC Type (UXO, DMM, or both)	Potential Hazards/ Severity	Expected Fragmentation Distance	Detection Depth (inches)	Approx. Diameter	Approx. Length
M301 81mm Illumination projectile	DMM	Pyrotechnic/Illumination	1067 ft	26	81 mm (3.18 inches)	571mm mm (22.5 inches)

DMM=discarded military munitions

UFP-QAPP Worksheet #12: Measurement Performance Criteria (UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Table 12-1. Measurement Performance Criteria

Measurement	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
Site Preparation			
1. Grids: UXO-assisted establishment and brush clearance	Completeness	Grid placement at 100 ft x 100 ft (or partial grids thereof) and brush clearance to the extent it does not interfere with access for DGM collection.	Visual inspection and approval by the UXOQCS
2. Grids: Instrument-assisted surface sweep	Completeness	100% removal of all MEC and MPPEH and all metallic debris 1.0 inches x 1.5 inches or larger. To reduce the metallic influence on the DGM data.	Minimum of 10% inspection of cleared surface area to confirm removal. Minimum of 1 surface seed recovered per surface cleared grid.
Sampling Design			
3. Detection threshold (grids)	Sensitivity	The detection threshold is 5 x root-mean-squared (RMS) noise.	Initial verification at IVS
Data Acquisition			
4. Positioning requirement (full coverage grid mapping and reacquisition)	Accuracy	Recorded measurement positions must be within 0.1 meter (m) of actual positions.	Review of sampling design, initial verification at IVS
5. Survey coverage (grids)	Accuracy/ Completeness	100% of specified acreage is sampled at the calculated lane spacing (0.8 m).	Data validation
6. DGM QC seeding (grids)	Accuracy/ Completeness	Contractor will place blind QC seeds at the rate of 1 seed/system/day. Planning documents must describe the blind seed firewall. The blind seed firewall plan is included Appendix H.	Lead agency (USACE Geo QA) verifies all QC seed failures are explained and corrective action implemented

Table 12-1. Measurement Performance Criteria

Measurement	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
Anomaly Resolution			
7. Anomaly resolution (DGM)	Accuracy/ Completeness	90% confidence < 1% unresolved anomalies. Accept on zero.	Verification checking with original instrument of anomaly footprint after excavation
8. Anomaly resolution (DGM)	Completeness	All items within 1.0 m laterally must be recovered for each flag.	QC Geophysicist (or designee) verifies
9. MEC/MPPEH disposition MEC/MDEH demolition	Accuracy	Donor explosives will be placed correctly for the type of munition(s) being destroyed. The disposal team will follow the guidance from USACE disposal manuals.	SUXOS performs visual verification of proper positioning of explosives for disposal
10. MEC/MPPEH disposition MEC/MDEH demolition	Accuracy	There will be no discrepancies in MEC accountability.	UXOQCS review of MEC Control Log
11. MEC/MPPEH disposition MEC/MDEH demolition	Completeness	All explosive materials (MEC and donor explosives) will be placed in a disposal shot, are consumed by the explosion, and there are no kick-outs.	SUXOS oversees an instrument-assisted visual verification of complete destruction by examination of disposal shot location and the surrounding area to look and listen for incomplete destruction and/or item kick-outs
12. MEC/MPPEH disposition MEC/MDEH demolition	Completeness	100% of all recovered MEC/MPPEH will be accounted for and properly disposed of.	UXOQCS review of MEC Control Log

Table 12-1. Measurement Performance Criteria

Measurement	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
13. MEC/MPPEH Disposition – Material Documented as Safe (MDAS) Disposition	Accuracy	Materials removed from the surface and subsurface will be correctly identified as MEC (UXO or DMM), MD, NMRD). MD and NMRD are identified by weight and type (by target for DGM, by grid for Analog, or by location for excavations).	SUXOS verification of correct materials category assignment for recovered materials to confirm measurement quality objectives (MQOs) IAW Worksheet #22
14. MEC/MPPEH Disposition – MDAS Disposition	Completeness	MPPEH that has been inspected and certified as MDAS will be segregated from other materials and stored in a locked container to prevent cross-contamination and is accounted for by weight. Final disposition is accounted for using a DoD Form 1348-1A when the material is certified and verified as MDAS.	SUXOS and UXOQCS visually inspects and reviews documentation to confirm MQOs IAW Worksheet #22
MC Sampling – Analysis			
Explosives by Method 8330B Perchlorate by Method 6850	Overall precision	*Soil (Discrete and Composite)* FD RPD ≤ 50% LCS/LCSD RPD ≤ 20% MS/MSD RPD ≤ 20% Confirmation Column ≤ 40% *Perchlorate* FD RPD ≤ 35% (water samples) FD RPD ≤ 50% (soil samples) LCS/LCSD RPD ≤ 15% MS/MSD RPD ≤ 15%	FD, TS, LCS/LCSD, MS/MSD, confirmation column
	Analytical accuracy/Bias (laboratory)	See Worksheet #28	LCS

Table 12-1. Measurement Performance Criteria

Measurement	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
	Accuracy/Bias (matrix)	See Worksheet #28	MSD
	Sensitivity	Limits of detection (LOD) meet comparison criteria (Worksheet 15)	Data assessment
	Completeness	>95%	Data assessment

Notes:

- The frequency of inspections is shown in Worksheet #22 for all applicable DFWs in this table.

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UFP-QAPP Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: UFP-QAPP Elements for Evaluating Existing Data)

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Past site use, previous activity, site characteristics	U.S. Army Corps of Engineers. *Final Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas*. Shaw Environmental, Inc. (Shaw), August 2016. U.S. Army Corps of Engineers. *Army Draft Summary Report – Soil Excavation at LHAAP-17 Longhorn Army Ammunition Plant, Karnack, Texas*. Bhate, November 2018. U.S. Army Corps of Engineers. *Army Draft Summary Report – Backfill of Clean Excavations at LHAAP-17, Longhorn Army Ammunition Plant, Karnack, Texas*. Bhate, October 2019.	LHAAP-17 historical background, location, potential MEC to be encountered, contaminants of potential concern and likely concentration ranges, and site characteristics	No known limitations
MC screening criteria	Soil MSC for Industrial Use Based on Groundwater Protection (GWP-Ind) from Texas Commission on Environmental Quality (TCEQ) Risk Reduction Rule (2006) https://www.tceq.texas.gov/remediation/rrr.html	To determine the quantitation limits that the data must meet to achieve the project objectives	No known limitations

Data type	**Source**	**Data uses relative to current project**	**Factors affecting the reliability of data and limitations on data use**
Topography and location	Google Earth	Surface water bodies and drainage, proximity to structures and roadways, vegetation density	Potential changes from last date of aerial
Meteorology	weather.gov Karnack, Texas https://www.weather.gov/unr/	Forecasts and estimations in seasonal temperature fluctuations, precipitation events, and associated stormwater runoff – these data will be used to evaluate schedule and site accessibility	No known limitations
Munitions characteristics	Fragmentation Data Review Form Database, DDESB, most current	Munitions fragmentation and overpressure characteristics will be used to develop safe work zones and work practices	No known limitations
Safety/Explosives Safety	Explosives Safety Submission Performance-Based Remediation (PBR) LHAAP-17 Longhorn Army Ammunition Plant Karnack, Texas. December. DESR 6055.09, Edition 1, Department of Defense Explosives Safety Board, January 13, 2019 (DoD, 2019). Department of Defense Instruction (DoDI) 4140.62, *Material Potentially Presenting an Explosive Hazard*. August 20, 2015, with Change 1 effective October 3, 2017, Department of Defense, 2017 (DoD, 2017). Engineering Manual 200-1-15, *Technical Guidance for Military Munitions Response Actions*, U.S. Army Corps of Engineers, October 2018 (USACE, 2018).	Safe, DoD, and USACE-compliant work practices for munitions response	No known limitations

Data type	**Source**	**Data uses relative to current project**	**Factors affecting the reliability of data and limitations on data use**
	Engineering Manual 385-1-1, *Safety and Health Requirements*, November 30, 2014, U.S. Army Corps of Engineers, 2014 (USACE, 2014). Engineering Manual 385-1-97, *Safety-Explosives, Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated April 12, 2013, U.S. Army Corps of Engineers, 2013 (USACE, 2013).		
UFP-QAPP Development	Intergovernmental Data Quality Task Force, *Uniform Federal Policy for Quality Assurance Project Plans*, EPA-505-B-04-900A, March 2005. (IDQTF) Intergovernmental Data Quality Task Force, *Optimized UFP-QAPP Worksheets*, March 2012. Intergovernmental Data Quality Task Force, *Advanced Geophysical Classification for Munitions Response*, March 2016. Intergovernmental Data Quality Task Force, *UFP-QAPP, Munitions Response QAPP Toolkit, Module 1: Remedial Investigation (RI)/Feasibility Study (FS)*, 2018.	Establishing DQOs, sample design, work planning and plan development	No known limitations
Geophysical survey	EM61, *Response of Standard Munitions Items*, Naval Research Laboratory/MR/6110-08-9155, 2008. (NRL)	EM61 sensor will be used during DGM to detect possible discrete MEC items within the site; response curves will be used to assess instrument functionality	No known limitations

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
	Environmental Security Technology Certification Program, *Geophysical Systems Verification: A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response*, August 2009.		

UFP-QAPP Worksheets #14 & 16: Project Tasks and Schedule
(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

This worksheet presents each of the DFWs and associated work elements, responsible parties, and deliverables. The planned project schedule is also provided.

DFW	Responsible Party	Expected Start Date	Expected Completion Date	Deliverables	Deliverable Due Date
Work Planning	MMG-TLI JV	September 2020	April 2021	Final UFP-QAPP	August 2021
	MMG-TLI JV	September 2020	January 2021	Final ESS	May 2021
TCRA Field Activities	MMG-TLI JV	September 2021	November 2021	Weekly Project Status Reports (PSRs)	Weekly
DFW 1 Site Preparation – Work Element 1: Utility Clearance	Local on-installation contractor	September 2021	September 2021	Installation documentation	(RACR) April 2022
DFW 1 Site Preparation – Work Element 2: Civil Survey	Texas Professional Land Surveyor (PLS)	September 2021	September 2021	Civil Survey	(RACR) April 2022
DFW 1 Site Preparation – Work Element 3: IVS Installation and ITS Installation	MMG-TLI JV	September 2021	September 2021	IVS Memorandum (EM61)	(IVS Memo) September 2021
DFW 1	MMG-TLI JV	October 2021	October 2021	IVS Technical Memorandum	Daily

DFW	**Responsible Party**	**Expected Start Date**	**Expected Completion Date**	**Deliverables**	**Deliverable Due Date**
Site Preparation – Work Element 4: Assemble and verify correct operation of EM61 sensor and initial IVS testing					
DFW 2 Data Management	MMG-TLI JV	October 2021	November 2021	Details in Worksheet #29	(RACR) April 2022
DFW 3 Grid Establishment for DGM Grids – Work Element 1 UXO assisted Brush Clearance	MMG-TLI JV	October 2021	October 2021	Field logbooks and notes	Daily
DFW 3 Grid Establishment for DGM Grids – Work Element 2 Civil Survey Grid Locate	MMG-TLI JV	October 2021	October 2021	Project GIS database	Daily
DFW 3 Grid Establishment for DGM Grids – Work Element 3 Grid Instrument Assisted Surface Sweep	MMG-TLI JV	October 2021	October 2021	Hand tablets or field data/grid sheets	Daily

DFW	**Responsible Party**	**Expected Start Date**	**Expected Completion Date**	**Deliverables**	**Deliverable Due Date**
DFW 3 Grid Establishment for DGM Grids – Work Element 4 QC Production Seeding	MMG-TLI JV	October 2021	November 2021	Seed Tracking Log	Daily
DFW 3 Grid Establishment for DGM Grids – Work Element 5 EM61 Grid Data Collection	MMG-TLI JV	October 2021	November 2021	Field Notes, DGM Data, GIS Database	Daily
DFW 3 Grid Establishment for DGM Grids – Work Element 6 Data Processing and Selection of Targets	MMG-TLI JV	October 2021	November 2021	DGM Data Deliverables (Target Maps, Project Database)	(Dig list) May 2021
DFW 3 Grid Establishment for DGM Grids – Work Element 7 Data Usability Assessment (DUA)	MMG-TLI JV	September 2021	December 2021	DUA	30 days following completion of data collection
DFW 4 Anomaly Reacquisition	MMG-TLI JV	November 2021	November 2021	Daily reports, Access database containing	Daily

DFW	Responsible Party	Expected Start Date	Expected Completion Date	Deliverables	Deliverable Due Date
				required tables, and GIS database	
DFW 5 Removal Grids – Work Element 1 Removal of DGM TOI	MMG-TLI JV	November 2021	November 2021	GPS and photographs	Daily
DFW 5 Removal Grids – Work Element 2 Resolution of Targets	MMG-TLI JV	November 2021	November 2021	Hand tablets or field data/grid sheets	Daily
DFW 7 MEC/MPPEH Disposition – Work Element 1 MEC/MDEH Demolition DFW 5	MMG-TLI JV	September 2021	November 2021	MEC Control Log and SUXOS Daily Report	Daily
DFW 7 MEC/MPPEH Disposition – Work Element 2 MDAS Disposition	MMG-TLI JV	September 2021	November 2021	Field logbooks, DoD Form 1348-1A	Daily
MC Sampling Field Activities	MMG-TLI JV	September 2021	November 2021	Weekly PSRs	Weekly

DFW	**Responsible Party**	**Expected Start Date**	**Expected Completion Date**	**Deliverables**	**Deliverable Due Date**
DFW 1 Groundwater Extraction System Installation	MMG-TLI JV	September 2021	November 2021	Weekly PSRs	Weekly
DFW 8 Sample Collection	SMMG-TLI JV	September 2021	November 2021	Analytical data packages and SEDDs	As occurs
DFW 9 IDW Management	MMG-TLI JV	September 2021	November 2021	Waste tracking log	As occurs

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UFP-QAPP Worksheet #15a: Screening Criteria and Laboratory-Specific Detection/Quantitation Limits – Primary Laboratory
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil (discrete or composite) Analytical Method: 8330B Concentration Level (if applicable): Low

Analyte	Chemical Abstract Service (CAS) Number	TCEQ GWP-Ind MSCs Industrial Soil (mg/kg)[c]	Screening Criteria (mg/kg)[d]	Laboratory-specific limit of quantitation (LOQ) (mg/kg)	Laboratory-specific LOD (mg/kg)
COC and COECs[a, b]					
2,4,6-TNT	118-96-7	5.1	NA	0.100	0.075
2,4-DNT	121-14-2	0.042	NA	0.100	0.075
2,6-DNT	606-20-2	0.042	NA	0.100	0.075
Post-Detonation Analyte					
1,3,5-trinitrobenzene	99-35-4	310	310	0.100	0.075
1,3-dinitrobenzene	99-65-0	1.0	1.0	0.100	0.075
2-amino-4,6-DNT	35572-78-2	1.7	1.7	0.100	0.075
2-nitrotoluene (o-nitrotoluene)	88-72-2	100	100	0.100	0.075
3-nitrotoluene (m-nitrotoluene)	99-08-1	100	100	0.100	0.075
4-amino-2,6-DNT	19406-51-0	1.7	1.7	0.100	0.075
4-nitrotoluene (p-nitrotoluene)	99-99-0	100	100	0.100	0.075
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	2.6	2.6	0.100	0.075
Nitrobenzene	98-95-3	5.1	5.1	0.100	0.075
Nitroglycerin	55-63-0	0.72	0.72	1.00	0.500
N-methyl-n,2,4,6-tetranitroaniline (Tetryl)	479-45-8	100	100	0.100	0.075
octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	510	510	0.100	0.075
pentaerythritol tetranitrate (PETN)	78-11-5	4,100	4,100	1.00	0.500

Notes:

[a] = Chemical of Concern (COC) (Source: Table 2-10, Final Record of Decision, LHAAP-17, Burning Ground No.2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, September 2016 [Shaw 2016])
[b] = Chemical of Ecological Concern (COEC) (Source: Table 2-11, Final Record of Decision, LHAAP-17, Burning Ground No.2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, September 2016 [Shaw 2016]). Note the TCEQ GWP-Ind MSCs are less than the ecological screening criteria for the COECs.
[c] = Soil MSC for Industrial Use Based on Groundwater Protection (GWP-Ind) from TCEQ Risk Reduction Rule (2006).
[d] = Screening criteria for post-detonation analyte.
Shading = The lowest available LOQ and LOD do not meet the comparison values (i.e., TCEQ GWP-Ind MSCs Industrial Soil [Note c] and/or Screening Criteria [Note d]). The laboratory will report detections down to the detection limit; however, the uncertainty associated with non-detected results will be addressed in the RACR.
MSC = medium-specific concentration
NA = Not Applicable

UFP-QAPP Worksheet #15b: Screening Criteria and Laboratory-Specific Detection/Quantitation Limits – Primary Laboratory
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil (discrete or composite) Analytical Method: 6850 Concentration Level (if applicable): Low

Analyte	Chemical Abstract Service (CAS) Number	TCEQ GWP-Ind MSCs Industrial Soil (mg/kg)[b]	Screening Criteria (mg/kg)[c]	Laboratory-specific limit of quantitation (LOQ) (mg/kg)	Laboratory-specific LOD (mg/kg)
COCs[a]					
Perchlorate	14797-73-0	7.2	NA	0.002	0.001

Notes:

[a] = COC (Source: Table 2-10, Final Record of Decision, LHAAP-17, Burning Ground No.2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas, September 2016 [Shaw 2016])

[b] = Soil MSC for Industrial Use Based on Groundwater Protection (GWP-Ind) from TCEQ Risk Reduction Rule (2006).

[c] = Screening criteria for post-detonation analyte.

MSC = medium-specific concentration

NA = Not Applicable

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UFP-QAPP Worksheet #17: Munitions Response Design and Project Work Flow
(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

As presented in the current CSM (Worksheet #10), LHAAP-17 is a site where MEC or other MPPEH is known and is potentially present in the surface and subsurface within the limits of the currently identified LHAAP-17 site as a result of intentional burning/detonation (disposal). MEC or other MPPEH is also potentially present within the site (at a maximum depth of 7 ft but expected to be much shallower) due to the nature of disposal operations. Note that detection depths are typically less than 7 ft and for the smallest items, significantly less.

Chemical Warfare Materiel (CWM) is not anticipated. However, if suspect CWM is encountered during any phase of site activities, all operations will cease, and the site will be evacuated up wind. The OESS will be contacted for further assistance and guidance.

LHAAP-17 is a 3.9-acre site located within a heavily wooded section in the southeastern portion of LHAAP and has two 185 feet-by-305 feet cleared areas, separated by a gravel access road. The location of LHAAP-17 within LHAAP, is shown on **Figure ES-2**. LHAAP-17 is undergoing remedial action in accordance with the final *Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack Texas*, Final, September (Shaw, 2016). A detailed description of the remedy and its planned implementation is presented in the *Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas* (Bhate Environmental Associates, Inc. [Bhate] 2019).

Soil excavation to remove contaminated soil and installation of a groundwater extraction system are major components of the selected remedy for LHAAP-17. These activities require extensive intrusive work (i.e., digging) which introduces an imminent and substantial risk due to potential encounters with MEC.

The project objective is to complete a TCRA to significantly reduce, mitigate or eliminate the potential threat of an encounter with Munitions and Explosives of Concern (MEC) to the public (i.e. off-path Caddo Lake National Wildlife Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016).

The primary TCRA activities include performing vegetation clearance with mechanized equipment and hand-held powered equipment; complete soils excavation utilizing remotely operated and robotic EMM, install groundwater extraction components; surface sweep for MEC by establishing search lanes in 100 ft x 100 ft grids with hand-held detectors (Schonstedt GA-52cX or equivalent); full-coverage DGM with EM61-MK2 coupled with Trimble Real-Time Kinematic RTK Global Positioning System (GPS) across each grid in either push-cart or person portable litter mode as dictated by terrain/topography, utilizing analog survey with hand-held detectors (Schonstedt GA-52cX or equivalent) only where DGM coverage is impracticable; subsurface removal of TOI by reacquiring anomaly locations with the EM61-MK2 and RTK GPS; removal and inspection of anomalies with hand tools and assisted by EMM to remove overburden where applicable; segregate MPPEH from existing soil stockpiles and newly excavated soils utilizing remotely operated screening equipment; process and manage MPPEH and MEC; and soil sampling.

The TCRA activities have been organized into DFWs. DFWs are not necessarily identified consecutively. Field activities will overlap. All fieldwork will be completed in accordance with the plans presented in Appendix A through Appendix J. The DFWs for the project are presented below.

17.1 Definable Features of Work Project Planning

Project planning in support of this TO entails a PMP prepared for USACE, an ESS prepared for DDESB approval, and a comprehensive UFP-QAPP for TCEQ and EPA concurrence. The PMP was prepared IAW EM 200-1-15 and identifies how the TO will be managed. The PMP specifies the technical approach to achieving the performance objectives; provides the management approach, key personnel, key subcontractors, communications plan, and quality management practices; and provides a fully developed, activity-based Project Schedule including payment milestones. The ESS identifies the site-specific explosives safety measures to be implemented during the fieldwork and was approved by the DDESB on May 20, 2021.

The UFP-QAPP documents the results of systematic planning (guided by *EPA QA/G4 Guidance on the Systematic Planning using the Data Quality Objectives Process* [EPA, 2006]) to include the data to be collected, the rationale and procedures for its collection, the associated QC and QA requirements, and the resulting decisions that will be made. This UFP-QAPP (optimized worksheet format) has been prepared IAW all relevant and current guidance including the recently published MR QAPP Toolkit (IDQTF, 2018). The completed UFP-QAPP worksheets are supported by a series of pertinent, appended documents including the APP/SSHP (to include Activity Hazard Analyses (AHAs) for each DFW); SOPs for MEC activities, MC sampling, and laboratory activities; an EPP, EMP, and WMP; and laboratory certifications. SOPs provide detailed procedures for common tasks that are non-site-specific. In the event approved plans conflict with SOPs, the conflict will be brought to the attention of the PDT for resolution and the final decision documented. Laboratory certifications are provided to demonstrate the qualifications of the selected subcontracted laboratory. MMG-TLI JV will monitor for certification expiration/renewal throughout the life of the project. Together with the ESS, the UFP-QAPP and its associated sub-plans serve as the work plan for the TCRA. This UFP-QAPP is supported by following existing and approved plans:

- *Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas* (Bhate Environmental Associates, Inc. [Bhate] 2019).
- *Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant*, Bhate, May 2018.
- *Explosives Safety Submission Performance-Based Remediation (PBR) LHAAP-17 Longhorn Army Ammunition Plant Karnack, Texas*, December 2020.

Documentation: Documentation resulting from project planning is elaborated throughout Section 17.1 and documented in Worksheet #9.

17.2 Mobilization

In preparation for the TCRA, the MMG-TLI JV PM and MR Operations Manager will review the training requirements and certifications to ensure assigned personnel meet or exceed the requirements identified in Worksheets #4, #7, and #8. All personnel mobilized to LHAAP in support of field activities will have credentials for site entry and appropriate levels of HAZWOPER training, including current 8-hour refreshers. UXO personnel will additionally be vetted for appropriate DDESB TP-18 standards (training and experience) and to ensure they are qualified by the Bureau of Alcohol, Tobacco, and Firearms (ATF) as Employee Possessors. All field personnel will be trained and medically screened per 29 Code of Federal Regulations (CFR) 1910.120.

The TCRA organization, including the field and support team, will be as presented in Worksheets #3 and #5.

Mobilization will take place in multiple phases. The first phase may be conducted concurrently with completion of the Final UFP-QAPP and will not include execution of work. This phase may include the MR Operations Manager, SUXOS, and UXOSO/UXOQCS to establish site operations, receive equipment, prepare for the arrival of the remaining field staff, confirm all personnel qualifications against assigned positions, confirm medical clearance documentation, and perform/receive site-specific training. The other mobilizations will include the addition of the remaining field staff as needed to complete the field activities.

Following mobilization to the site, all personnel engaged in field activities will additionally receive installation-specific and site-specific training to ensure compliance with LHAAP regulations and procedures and adherence to the approved planning documents.

At the start of site work each day, the UXOSO (also serving as the Site Safety and Health Officer [SSHO]) will conduct a tailgate safety briefing to reinforce employee and subcontractor awareness of hazards and mitigation procedures. Each team member will sign the safety log, acknowledging that they have participated in the tailgate safety meeting. Operations at LHAAP-17 will be properly explosively sited IAW the Explosives Safety Submission (ESS). Prior to commencing MEC operations, the SUXOS will establish and secure the explosives safety exclusion zones documented in the ESS (**Figure 17-1** and **Figure17-2**). The SUXOS will maintain the security of the explosives safety exclusion zone(s) using barricades or cones at access control points to limit access to essential personnel during operations.

Throughout excavation and sifting operations, dust will be minimized with best management practices (BMPs) established in the EPP (Appendix B to this UFP-QAPP).

A mobile soil screening operation consisting of a Sandvik QE441 screener with ¾ inch screens and two Anaconda stackers with cross belt magnets will be established within LHAAP-17 (**Figure ES-3).** This mobile system may be moved within LHAAP-17 for access and efficiency.

Photograph 1: Screening Plant

A MPPEH processing area will be established in the cleared area to the north of LHAAP-17, on the south side of the road running through the clearing (**Figure 17-1)**. All material recovered from the sifting operation will be managed as MPPEH and transported to the MPPEH processing area for inspection, certification, and verification IAW the requirements of DoDI 4140.62 (DoD, 2019) prior to off-site disposition. Through this process, material will be segregated into non-metallic miscellaneous debris, NMRD, MDAS, and MDEH. MPPEH processing and segregation of materials is further detailed in **Section 17a.6**.

A grounded and explosives safety sited Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) Type 2 explosives storage magazine (compliant under 27 CFR 555.208) will be placed on-site during the MEC identification/removal phase and will be secured within the same fence for temporary storage of recovered MEC that is safe to move.

Throughout the conduct of the TCRA, truck routes will be followed that take into consideration the weight limits of bridges within LHAAP in order to reduce risk of damage to the bridges. The truck routes for loaded and unloaded haul trucks previously used for the 2019 soil removal was effective and will continue to be used as illustrated in **Figure 17-3**. Loaded trucks will exit LHAAP-17 to the south onto Q Avenue.

Office space has been provided by our teaming partner Bhate, and all field documents will be maintained there during the execution of the field activities.

Documentation: All training will be documented on a Record of Training form and checked by the UXOSO/UXOQCS for completeness. See Worksheet #29 for project documentation details.

17.3 Verification and Installation of Erosion and Storm Water Control Measures and Draining of Impounded Water Management

Erosion and storm water control measures will be installed as described in the EPP (Appendix B to this UFP-QAPP). These include implementing sediment, erosion, structural, and vegetative controls to mitigate runoff, particularly to existing ditches. The ditches requiring protection from runoff are illustrated in Figure 1 of Attachment 1 to the EPP. Existing berms for erosion control are shown on **Figure ES-3.** These berms and positive grading will be used to divert surface water runoff away from open excavations and to prevent stormwater from within excavation areas from flowing out. If additional berms are needed to control erosion, run-on to LHAAP-17 or the open excavations, or runoff into the ditches beyond the three locations illustrated in **Figure ES-3**, berms will be installed following the draining of impounded water from the existing excavation. Good construction management techniques and minimizing the clearing of vegetation will be implemented.

The planned TCRA activities cannot be accomplished safely in standing water. Impounded water in open excavations will be pumped from open excavation and discharged IAW procedures agreed to by Army, TCEQ and EPA. Additional detail regarding impounded water is provided in the EPP (Appendix B).

17.4 Borrow Source and Excavated Soil Characterization

Native soil fill from the Moore Pit located approximately 6 miles east of Karnack, Texas, was previously approved for use at the site. Additional borrow material for backfilling of the remaining excavations is anticipated to be taken from the same source. Soil samples from the source borrow will be collected at a rate of one sample per 1,000 CY for USACE approval prior to site mobilization. Open excavations will be backfilled. The total estimated volume of backfill expected prior to potential over-excavation at Areas H, J, K, L, and M, is 4,850 banked CY. This will be the minimum required to restore these areas, contingent upon additional over-excavation needs.

The borrow material source will be approved based on clean sample results. Borrow source material will be considered clean if volatile organic compounds, explosives, and perchlorate are below the Texas Commission of Environmental Quality Risk Reduction Standard Medium Specific Concentrations for industrial use and metals are below documented background levels as defined by the Risk Reduction Standard Number 2 Groundwater Protection-Industrial or the LHAAP 95% Upper Tolerance Limit Background value.

While a clay soil is preferred for the bulk of backfill, consistent with previously approved plans, the upper 6 to 12 inches of topsoil will be of a soil type that allows native grasses to properly develop and avoid Bahia grasses from overtaking the site. SB-2, a native crushed stone derived from granite, may be used in place of soil in excavations that breech the groundwater table to mitigate groundwater infiltration.

Excavated soils have been characterized for off-site disposal using samples collected from the existing soil stockpiles. It is anticipated that soil will still be classified as non-hazardous. To update the waste profile, Waste Connections requires SOPs of the MPPEH soil screening processes and methods that, when reviewed, will confirm that risks from MEC, as discovered from previous disposal efforts, have been removed prior to shipment of waste soil to the Waste Connection facility. The total estimated volume of soil for off-site disposal includes 2,000 CY in existing soil stockpiles, with potentially 3,000 CY remaining to be excavated.

17.5 Preliminary Munitions Response Objective

The primary objective of the TCRA is to significantly reduce, mitigate or eliminate the potential threat of an encounter with Munitions and Explosives of Concern (MEC) to the public (i.e. off-path Caddo Lake National Wildlife Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016). The TCRA may be expanded beyond site boundaries as needed. The TCRA approach is presented by DFW and associated work elements and sub-elements as follows:

Munitions and Explosives of Concern Identification and Removal (See Worksheet # 17a)

- DFW 1: Site Preparation (Worksheet #17a)
  - Work Element 1: Utility Clearance
  - Work Element 2: Civil Survey
  - Work Element 3: IVS Installation, and ITS Installation
  - Work Element 4: Assemble and Verify Correct Operation of EM61 Sensor and Initial IVS Testing
- DFW 2: Data Management (Worksheet #17a)
- DFW 3: Grid Establishment for DGM Grids (Worksheet #17a)
  - Work Element 1: UXO Assisted Brush Clearance
  - Work Element 2: Civil Survey Grid Locate
  - Work Element 3: Grid Instrument-Assisted Surface Sweep
  - Work Element 4: QC Production Seeding
  - Work Element 5: EM61 Grid Data Collection
  - Work Element 6: Data Processing and Selection of Targets
  - Work Element 7: Data Usability Assessment
- DFW 4: Anomaly Reacquisition (Worksheet #17a)
- DFW 5: DGM Grid Removal, Inspection and Resolution of Targets (Worksheet #17a)
  - Work Element 1: Removal and Inspection of DGM Targets
  - Work Element 2: Resolution of DGM Targets

- DFW 6: Achieve Excavation and Installation of Groundwater Extraction System Components
    - Work Element 1: Soil Movement and Screening
    - Work Element 2: Soil Excavation
    - Work Element 3: Confirmation Sampling and Over Excavation
    - Work Element 4: Groundwater Extraction System Component Installation
    - Work Element 5: Staging of Soil
- DFW 7: MEC/MPPEH Disposition (Worksheet #17a)
    - Work Element 1: MEC/MDEH Demolition
    - Work Element 2: MDAS Disposition

Munitions Constituents Sampling (see Worksheet #17b)

- DFW 8: Sample Collection (Worksheet #17b)
- DFW 9: IDW Management (Worksheet #17b)

Documentation: Field activities will be documented in the RACR. See Section 17.6.

17.5 Site Restoration

Upon completion of field activities, disturbed areas will be restored to their original condition. Temporary facilities will be removed and roads repaired as needed. All pin flags and grid stakes will be removed. Site restoration will consist of backfilling of excavated holes and the removal and disposal of all IDW.

Decontamination of equipment will be performed as per RD/RAWP (Bhate 2019) and SOP A1-Decontamination Procedures in Appendix A of the IWWP (Bhate, 2018).

In those portions of existing excavations where confirmation samples have already been accepted (**Figure 17-4**), backfilling will occur as soon as practical following draining of impounded water. This partial backfilling step is an effort to mitigate the potential of additional water accumulation while the remainder of the excavation is being established as clean. Otherwise, backfilling will occur as soon as possible to mitigate further accumulation of precipitation (i.e., as soon as the removal of subsurface anomalies is completed and excavation sidewall and floor confirmation samples document soil left in place is below LHAAP-17 cleanup levels, or in the case of attaining groundwater depth, the COC/COECs levels of soil left in place have been documented. Soil from the approved borrow source will be placed into open excavations and compacted with the backhoe/excavator bucket to prevent settling.

The site will be seeded using a native grass and wildflower seed mixture with guidance from the United States Fish and Wildlife Service (USFWS). Typically, a combination of Eastern Savannah Grass Mix (Item #2805) and a Cereal Rye Grain (Item #8050), each from Native American Seed, is used. Erosion control measures such as mulch and fabrics may be placed to prevent surface water runoff until the site is sufficiently vegetated.

Documentation: Site restoration activities will be documented in field logbooks, photographs, and the RACR Report.

17.6 Reporting

MMG-TLI JV will complete a RACR for LHAAP-17. The RACR will document the following and will be submitted for TCEQ and EPA Region 6 acceptance:

- LHAAP-17 site description, history, physical characteristics, current and future land use, and boundaries;
- Detailed description of all TCRA activities completed;
- A description of the data collection methods and analysis, including tabular presentation of results, as appropriate;
- Observations and findings associated with soils excavation and sifting, geophysical survey, removal and inspection of subsurface anomalies, and environmental media sampling;
- Revised MEC and MC CSMs based on the results of the TCRA;
- Assessment of the residual MEC hazard and potential MC risks to human health and ecological receptors, as appropriate;
- Appended laboratory analytical data reports with all chemical quality control results; and
- Appended scanned field data sheets and/or logbooks.
- Soil sampling results will be screened against the criteria in Worksheet #15. If analytical results for soil samples collected during TCRA fieldwork exceed the screening criteria, hot-spot removal of soils will be completed.

<u>**Documentation:**</u> Reporting documentation is elaborated on throughout Section 17.5

UFP-QAPP Worksheet #17a: Sampling Design and Rationale for Munitions and Explosives of Concern and Material Potentially Presenting an Explosives Hazard

(UFP-QAPP Manual Section 3.1.1)

(EPA 2106-G-05 Section 2.3.1)

17a.1 Definable Feature of Work 1: Site Preparation

17a.1.1 Definable Feature of Work 1, Work Element 1: Utility Clearance

A local on-installation contractor will be used to provide the necessary utility clearance.

Documentation: Installation documentation of utility clearance will be provided in electronic format. See Worksheet #29 for project document details.

17a.1.2 Definable Feature of Work 1, Work Element 2: Civil Survey

Control points within the site boundary (**Figure ES-3**) will be established by a Texas Professional Land Surveyor (PLS) based on the georeferenced site boundaries supplied by the USACE. The civil survey team will be escorted by UXO-qualified personnel to provide anomaly avoidance as required in MEC SOP 18-01-01.

The limits to be excavated (minimally including the excavation areas identified in the RD/RAWP (Bhate 2019) will be determined and identified in the field using global positioning system (GPS) equipment for Areas H and J in coordination with USACE and IAW Section 3.3 of the IWWP. The SUXOS will direct the placement of stakes by the MMG-TLI JV field staff to establish the grids within LHAAP-17.

A professional land surveyor licensed in the State of Texas will survey the final horizontal excavation limits. All civil survey work will be performed IAW EM 200-1-15.

Documentation: The PLS will provide the control point survey in electronic format. See Worksheet #29 for project document details.

17a.1.3 Definable Feature of Work 1, Work Element 3: IVS Installation and ITS Installation.

An IVS will be constructed. Two small Industry Standard Objects (ISOs) will be buried in the IVS. A background lane will be separated from the IVS lane by at least 2 meters. ISO seeds will be buried at approximately five to seven times their inner diameters in vertical and/or horizontal orientations. The construction of the IVS will be performed in accordance with SOP Geo-3.

An ITS will be implemented by the UXOQCS to verify hand-held analog detectors and their operators’ ability to detect subsurface anomalies. ISOs will be placed in near horizontal or vertical positions. The ITS will be placed in a convenient and accessible location that represents typical terrain and soil conditions found within the site.

In addition, the locations selected for the ITS and IVS will be cleared of all detected metallic anomalies. Hand-held tablets are planned to be used to document instrument-assisted surface sweep details. Alternately, field data/grid sheets may be used. Tablets will be downloaded to the Project Database daily. The information (type, identification number, location) on the QC coverage seeds will be documented on a Seed Tracking Log. Details will additionally be captured in field logbooks, the SUXOS Daily Report, and DQCRs. See Worksheet #29 for project document details.

Documentation: IVS Technical Memorandum (EM61).

17a.1.4 Definable Feature of Work 1, Work Element 4: Assemble and Verify Correct Operation of EM61 Sensor and Initial Instrument Verification Strip Testing

The geophysical sensors will be assembled as described in SOP GEO-2a. As part of the Geophysical System Verification (GSV) process, the DGM team will complete an initial survey of the IVS to assess background noise and to confirm the geophysical system is operating properly and that the DGM team is well trained in its operation as described in SOP Geo-3. After completing the initial EM61 IVS testing, an IVS Technical Memorandum will be prepared detailing the IVS setup, EM61 surveys, and results including documentation of compliance with the MQOs provided in Worksheet #22. The IVS Technical Memorandum will be provided to the project team for review and concurrence.

Documentation: IVS Technical Memorandum.

17a.2 Definable Feature of Work 2: Data Management

All geophysical, target, clearance results, and QC data will comprise the Project Database and will be managed by combined AECOM and TLI off-site Data Managers. The data entry system will be formatted to control and maintain consistent database input.

Documentation: Instrument-assisted surface sweep, DGM target and grid data, as well as reacquisition and anomaly inspection data will be recorded on electronic devices (i.e., tablets), downloaded, backed up daily, and stored at a separate location to secure data in the event of a computer failure. Field data/grid sheets may also be used. The Data Manager will review the previous day’s inputs for inconsistencies and incomplete records. The Data Manager will also provide data to GIS support staff for inclusion in weekly reports. The UXOSO/UXOQCS will conduct audits of instrument-assisted surface sweep and subsurface removal/inspection downloads to the Project Database, and the QC Geophysicist will conduct audits of the related downloads to the Project Database to ensure completeness and accuracy. See Worksheet #29 for project documentation details.

17a.3 Definable Feature of Work 3: Grid Establishment for Digital Geophysical Mapping Grids

After the site boundary has been delineated, MMG-TLI JV will establish 100x100-ft full grids and partials within the site boundary for surface sweep and subsequent DGM collection.

17a.3.1 Definable Feature of Work 3, Work Element 1: Unexploded Ordnance Assisted Grid Establishment and Brush Clearance

The MMG-TLI JV will self-perform this effort with a three/five-person UXO team, removing brush that could impact the surface sweep and DGM data collection. The team will use hand tools and field mowers to cut grass and reduce brush to six inches above the ground surface and six ft for limb removal for trees larger than four inches in diameter.

Documentation: Team logbooks and field notes will be used to document this field activity.

17a.3.2 Definable Feature of Work 3, Work Element 2: Civil Survey Grid Locate

The MMG-TLI JV will escort our sub-contracted state licensed surveyor for this effort with a three-person Survey/UXO team, utilizing the sub-contracted state-licensed PLS control points to locate and establish the four corners of each grid utilizing Robotic Total Station RTS/RTK or similar GPS equipment (**Figure 17-5**). Each grid corner will be located by using a standard survey nail (with marking tape) and a 4-ft wooden stake (with marking tape). Grids will be given a standard naming convention on the wooden stakes (example A01.1, A01.2, A01.3, and AMG01.4). The grid survey team will be escorted by UXO-qualified personnel to provide anomaly avoidance as required in MEC SOP 18-01. All civil survey work will be performed IAW EM 200-1-15.

Documentation: All positional data will be maintained in an electronic format (.csv file) and will be uploaded to the project GIS database daily. See Worksheet #29 for project document details.

17a.3.3 Definable Feature of Work 3, Work Element 3: Grid Instrument Assisted Surface Sweep

After UXO escorted grid establishment and brush clearance activities have been completed, an instrument -assisted surface sweep will be completed IAW MEC SOP 18-02 to remove all potential MEC and MPPEH and other metallic debris of a size (interpreted for this site as metallic debris 1.5 inches x 3 inches or larger) and/or density that would interfere with DGM.

Grid surface sweep of each grid will be cleared using ropes and tapes to establish lanes not exceeding 10 ft in width. Each surface sweep team member will sweep his/her lane up and back with an analog hand-held detector ensuring that each sweep is 5 ft wide. A Schonstedt GA-52cX or equivalent analog detector will be employed. Once a grid is cleared, the surface sweep Team Lead (TL) will record the quantities and type of MEC/MPPEH recovered, if any, and the weight of MD and any other NMRD recovered.

Documentation: Hand tablets are planned to be used to document instrument-assisted surface sweep details. Alternately, field data/grid sheets may be used. Tablets will be downloaded to the Project Database daily. Details will additionally be captured in field logbooks, the SUXOS Daily Report, and DQCRs, including photographs and description of any recovered MEC or MPPEH. See Worksheet #29 for project document details.

17a.3.4 Definable Feature of Work 3, Work Element 4: Quality Control Production Seeding

UXOQCS and the QC geophysicist will bury ISO items as part of the GSV process. QC seeds will be placed in all full coverage grids using a survey grade positioning system and photographed. QC seeds will consist of small Schedule 40 or 80 ISOs. QC seed information will be documented and provided to USACE; however, their locations will be kept blind to the DGM collection teams and processors. The QC Geophysicist will compare the DGM data and targeted locations and responses to the documented QC blind seed locations and expected responses. USACE will perform QA and may also conduct independent QA seeding.

Documentation: Seed Tracking Log

17a.3.5 Definable Feature of Work 3, Work Element 5: EM61 Grid Data Collection

All LHAAP-17 areas accessible to DGM survey equipment will be digitally mapped (including areas beneath existing soil stockpiles once removed and backfilled excavations). DGM survey team will collect data using a combination of cart system supplemented with person-portable litter mode as needed. The georeferenced positioning system will be Trimble RTK GPS. The EM61-MK2 cart system is well suited to collect geophysical data in the natural terrain/topography at LHAAP-17; however, some site features (excavation areas) may not allow favorable conditions for the cart system. In these areas, data may be collected with the person-portable single coil in litter mode. The accessibility and conditions of each feature will be determined on a case-by-case basis pending evaluation primarily of slope, topography, and footing. Deviations and inaccessible areas will be discussed with the USACE TM and BRAC Site Manager and documented in the field notes, daily reports, and GIS database. A GPS antenna will be mounted directly over the geophysical sensor to track its position. This system provides positional updates at a rate of 1 hertz (Hz), with an accuracy of approximately 3-centimeter (cm) horizontal when a minimum of five satellites are available. Geophysical data are collected at a rate of 10 Hz or more, with GPS positions at a rate of 1 Hz. If the terrain cannot be traversed in a wheeled configuration, the instrument can be carried by two operators in a “litter” configuration. In either configuration, data are collected in automatic mode at a rate of at least 10 Hz.

The geophysical instruments will be field-tested as part of the daily functional checks, as described in Worksheet #22 and the SOPs (Appendix F) and as a means of reviewing system performance.

Documentation: Field Notes, DGM Data, GIS Database.

17a.3.6 Definable Feature of Work 3 Digital Geophysical Mapping, Work Element 6: Data Processing and Selection of Targets

The JV will verify that all information is complete for each day of field activities and any changes or exceptions are documented and have been reported in accordance with requirements. The JV will verify that all MQOs have been achieved, with any exceptions noted, and that any necessary corrective actions have been completed and documented. Data from the DGM system will be processed and analyzed in accordance with SOP GEO-6 (Appendix F). Geophysicists will process and analyze the data to ensure it meets all requirements found in EM 200-1-15 and DID HNC-003. All EM61-MK2 data will be processed using Geosoft’s Oasis Montaj. The data will be leveled and any necessary corrections for positional latency applied. With concurrence from USACE, the JV will define a defensible method for making target selections. This will be documented in the IVS Technical Memorandum. In general, the target selection threshold will be a multiple, typically at least five times, of the background noise level. Target selection criteria will be set to a multiple of site noise to increase the probability of detection of the smallest munition present at LHAAP-17.

Using Geosoft’s Oasis Montaj with the UXO Land Module, targets will be auto-selected at peak (local maximum) values from the grid and/or profile data. Each of the anomalies selected by Geosoft as a target will be analyzed by a trained geophysicist and evaluated in terms of validity and position.

Targets found to be invalid or incorrectly located will be adjusted or removed. Additionally, anomalies that are not selected by the auto picker, yet deemed to represent a potential MEC target, will be manually selected. During the targeting process, areas determined to be too saturated with response to identify discrete targets will be defined as saturated response areas (SRAs). The SRA will be documented and the boundary of the SRA will be displayed on the map and documented within the project database. SRAs will then be surveyed and marked. Targets within an SRA will be identified and dug using low-input mechanized MEC procedures and resolved with analog methods. Once mechanical MEC procedures are complete, the area will be remapped to ensure only single point anomalies remain or that all anomalies have been removed.

The MMG-TLI JV will provide target maps and dig sheets for all surveyed areas. Submitted maps will include site features overlaid onto the geophysical data results. Dig sheets will contain a target identification (ID) number, geodetic coordinate location, peak amplitude of response for each target selection, and any appropriate comments relating to the anomaly and its characteristics. A MQO report is created for each dataset detailing compliance with DQOs. DGM data deliverables for each week’s data collection will be submitted by the second following Friday.

The project database will track all processing information as well as documentation of QC results. All data processing, target selection, and areas identified as SRAs will be reviewed by the Project Geophysicist prior to USACE QA submittal. See Worksheet #29 for documentation details.

Documentation: DGM Data Deliverables (Target Maps, Project Database).

17a.3.6.1 Definable Feature of Work 3 Digital Geophysical Mapping, Work Element 7: Data Usability Assessment

Upon completion of the data collection and processing, a data usability assessment (DUA) will be completed using the three-step process described in Worksheet #37, which requires review and acceptance by USACE. Usability will be based on achievement of DQOs and MPCs. The DUA report will be submitted 30 days following completion of data collection. The results of the DUA will be briefed during a scheduled monthly managers or special meeting and the DUA report included in the RACR for regulatory acceptance.

17a.4 Definable Feature of Work 4: Anomaly Reacquisition

Selected target anomalies in DGM grids will be staked using an RTK GPS. The anomaly location will then be flagged for excavation and resolution.

Documentation: Daily reports, Access database containing required tables, and GIS database.

17a.5 Definable Feature of Work 5, Digital Geophysical Mapping Grid Removal, Inspection, and Resolution of Targets

A UXO team made up of at a minimum one UXO Technician (UXOT) III, one UXOT II, and one UXOT I will perform the removal and inspection of selected anomalies utilizing hand tools and if necessary, EMM.

17a.5.1 Definable Feature of Work 5, Work Element 1: Removal and Inspection of Digital Geophysical Mapping Targets

Removal and inspection of the selected target anomalies will be performed by qualified UXOTs. Individual, selected target anomalies will be investigated to a maximum depth of detection below the ground surface (bgs) within LHAAP-17. Target anomaly excavations may be completed manually or with the assistance of EMM, as outlined in EM 385-1-97 (USACE, 2013).

Documentation: The location of all MEC/MDEH will be recorded with a GPS, and a photograph will be taken. A specific sequencing number to identify the grid and a sequential number to identify the MEC/MPPEH (e.g., A01-001) will be assigned. See Section 17a.3 for data management details and Worksheet #29 for project documentation details.

If MEC or MPPEH is discovered, its condition will be assessed prior to further disposition. Identification of suspected MEC and MPPEH will be made by a minimum of two UXO-qualified personnel. The SUXOS has ultimate responsibility for the proper identification of the item and its condition. MEC and any MPPEH that is determined to pose an explosive hazard (i.e., MDEH) will be managed as described in DFW 7, Work Element 1.

Any other metallic anomalies removed from the excavated soil material will be managed as MPPEH, inspected, and segregated as either MDAS or other, non-munitions-related metallic debris. MDAS disposition is further addressed in DFW 7, Work Element 2. All material recovered that is not associated with munitions will be inspected, certified, and verified and recycled IAW MEC SOP 18-06.

17a.5.2 Definable Feature of Work 5, Work Element 2: Resolution of Digital Geophysical Mapping Targets

100% of the targeted anomaly excavations will be resolved using the same technology as employed during the initial DGM survey (i.e., EM61). The cleared mV reading will be captured electronically. If the anomaly location cannot be cleared below the minimum mV reading then the UXOQCS will be required to verify the source of the remaining anomaly.

Documentation: The details of the results of the anomaly investigation (e.g., complete nomenclature, depth bgs, etc.) will be recorded on tablets and downloaded to the Project Database. Field data/grid sheets may also be used. Individual, selected target anomalies that cannot be resolved due to depth (i.e., in excess of 4 ft bgs) will be fully documented, including residual mV response. See Section 17a.3 for data management details and Worksheet #29 for project documentation details.

Following investigation and documentation of the excavated anomalies, the excavated soils will be staged and used to backfill the excavation.

17a.6 Definable Feature of Work 6: Achieve Excavation

Robotic movement, excavation, and screening of the existing soil stockpiles (**Figure ES-3**) and screening of newly excavated soils will be accomplished IAW SOPs detailing equipment operations provided in **Appendix F.5**. MEC explosives safety support will be provided during movement, sifting, and excavation. A qualified UXO Technician will be present throughout the process to provide visual observation and to be available to inspect and manage any potential MEC. Equipment will be fitted with cameras to facilitate live observation during all soil movement, excavation, and screening processes.

17a.6.1 Definable Feature of Work 6, Work Element 1: Soil Movement and Screening

A visual depiction of the soil screening work flow process is provided in **Figure 17-6**.

Soil and MPPEH movement will be completed using remotely operated EMM consisting of one John Deere 750 bulldozer or similar, one front-end loader, and one 200-class excavator for loading of soil into the screener. Operators of the remotely controlled EMM will be located at a safe distance from the equipment IAW the approved ESS. The remote 750 class dozer will push stockpiled soils to the screening operation where the second excavator will load the soil into the Sandvik QE441 screener. Lime may be introduced to the excavated and stockpiled soil material to reduce cohesion of the material for better results in the screening process. This may be required if soils are not adequately dry and the sift plant clogs because of wet clays.

Soil screening will be accomplished using a Sandvik QE441 screener with ¾-inch screens and two Anaconda stackers with cross belt magnets.

Soil will be fed and sorted into metallic debris to be transferred to the MPPEH processing area, “fines” for off-site disposal, “mids” to be re-processed thru sifter until these are reduced in size to “fines,” and “overs” to be transferred to the MPPEH processing area. The procedure is summarized as follows:

Once loaded, the soil will travel across a 3-inch top screen where any material 3 inches and larger will travel to the tail. The remaining material (i.e., “overs”) will be deposited to the ground. This step will effectively remove stones, root clumps, and miscellaneous large debris, which will help prevent fouling of the smaller screens.

Any material smaller than 3 inches will pass through the top screen and onto a ¾-inch bottom screen. Any material larger than ¾-inch but smaller than 3 inches will travel to the mid-side conveyor and under a rare earth cross belt magnet. The magnet will remove any ferrous metal and deposit it into a second 4-yard hopper. The remaining material (i.e., "mids") will continue to travel up the conveyor and be deposited on the ground. This material will be re-run through the entire process until it is properly reduced in size to "fines."

Anything smaller than ¾ inch will travel to the fines conveyor, which will be equipped with a rare earth cross belt magnet. The magnet will remove any ferrous metal and deposit it into a third 4-yard hopper. The remaining material (i.e., "fines") will continue to travel up the fines conveyor and be deposited onto the ground.

Hoppers of metallic material will be managed as MPPEH and transported using remotely operated EMM to the MPPEH processing area. "Overs" will also be transported using remotely operated EMM to the MPPEH processing area. "Fines" will be accumulated, transported, and disposed of off-site. MPPEH processing is further described in **Section 17a.6**.

17a.6.2 Definable Feature of Work 6, Work Element 2: Soil Excavation

Soil excavation in Areas H, J, K, L and M will be completed using remotely operated EMM consisting of one 200-class excavator. Operators of the remotely controlled EMM will be located at a safe distance from the equipment IAW the approved ESS.

In most areas, soil will be excavated from across the entire area to a depth of 2.5 ft below ground surface (bgs) to 3 ft bgs. Soil to this depth will have been subject to previous MEC investigation and removal. Newly excavated soil will be stockpiled approximately 4 ft from the edge of the excavation before being transported to the sift plant.

Isolated samples used for the remedy design and described in the RD/RAWP (Bhate, 2019) had contamination detected deeper than 3 ft but were clean at 7 ft bgs. In these excavation areas, the excavation floor will be sloped.

Sequencing of the remaining soil excavations is critical to achieving removal goals. The intended sequencing of excavations and the rationale for sequencing is described in **Table 17-1**. Actual sequencing of remaining soil excavations will be determined in the field based on field conditions and may be weather dependent. The excavations will continue to the projected limits and depths described, as surveyed by Bhate (**Figure 17-4**), except where noted in **Table 17-1** below or for over-excavation.

Table 17-1: Excavation Sequencing

Area	Excavation	Rationale
J	Complete excavation of approximately 1,250 square feet (sq ft) of sidewall in the south and southeastern portion of Area J to a depth of 5.5 ft bgs. Confirmation samples will be taken within the southern sidewalls following the additional excavation. Vertical extent of the excavation is defined based upon existing samples and considered complete.	The completion of this area first allows for reestablishment of the haul road and improved access into Area H.
H	Complete excavation of approximately 700 sq ft along the eastern edge of the Area H excavation and then collect confirmation samples. Approximately 5 ft of lateral over-excavation is required on the north end of the east wall and 10 ft of lateral over-excavation of the south end of the east wall is required to reach the original excavation extent. The vertical extent of the excavation is defined based upon existing samples for the western portion of the area. Confirmation samples will be taken from the northern and southern side walls as well as the excavation floor of the eastern portion (five floor samples, which were not previously collected as marked on **Figure 17-4**).	Similar to Area J, completion of this area will also allow reestablishment of the haul road.
K	Over-excavation to the south, of the eastern corner of the east wall, and east sidewalls is required to a depth of 2.5 ft. Documentation provided by USACE recommends approximately 5 ft lateral to the south and up to 15 ft lateral to the east. Confirmation samples from the sidewalls will be collected following over-excavation. Vertical extent of the excavation is defined based upon existing samples.	Completion of the furthest west area near the drainage ditch minimizes potential for excavation water discharge should a large rain event occur.
L	Over-excavation of the west and north sidewalls is required to a distance of 5 ft laterally and 2.5 ft vertically. Confirmation samples will be collected following over-excavation. The vertical extent of the excavation is defined based upon existing samples.	The order of Areas L, M, and N may vary in the field depending up on access and likely will be completed simultaneously due to proximity.
M	Over-excavation is required to the west, south, and north of the existing Area M excavation. The depth of the overall excavation is 2.5 ft. A portion of Area M also requires over-excavation of all the sidewalls to 7.5 ft or groundwater, whichever is shallower. Confirmation samples will be collected, with the exception of the floor where vertical extent is defined in the deeper portion of the excavation based upon existing data.	
N	Over-excavation of the south wall and shallow excavation floor is required. Confirmation samples will be collected following over-excavation.	

***Note:** Actual sequencing of remaining soil excavations will be determined in the field based on field conditions and may be weather dependent.

17a.6.3 Definable Feature of Work 6, Work Element 3: Confirmation Sampling and Over Excavation

Confirmation soil samples will be collected from sidewalls and floors employing a five-point composite method and analyzed for explosives constituents IAW the IWWP (Bhate, 2018) and RD/RAWP (Bhate, 2019). Aliquots of sidewall or floor soil may be collected from the composite locations with the excavator bucket if the excavation is deeper than 4 ft and the sidewalls are not sloped or benched. Each sample will represent up to 1,000 sq ft of excavation wall or floor. As noted in the RD/RAWP, small excavations (less than 400 sq ft of floor area and sidewall height of less than 6 ft) will use a four-point composite sidewall confirmation sample comprised of an aliquot from each sidewall. If the sidewall composite sample result is above the cleanup levels, then additional grab samples will be collected from each wall to determine which direction to over-excavate. Excavation floor sampling for small excavations will be performed IAW the IWWP (Bhate 2018) as described above, one sample per 1,000 sq ft of floor. **Table 17-2** presents the existing confirmation samples and the sidewalls and excavation floors still requiring over-excavation and confirmation sample collection, and **Figure 17-4** illustrates project sampling location needed to complete the confirmation sampling.

In locations where MEC or MD is recovered and removed, discrete samples will be collected and submitted for perchlorate analysis (Worksheet #15b). Confirmation analytics will be processed with expedited turnaround. Sidewall and floor sample results will be compared to the cleanup levels for COCs and COECs per the ROD.

If a confirmation exceeds the cleanup level for one or more constituents analyzed, the floor or wall will be over-excavated, screened for MEC, and then resampled for COCs/COECs. Over-excavation will be 5-ft laterally and 1-ft vertically (or until groundwater is encountered). This process of over-excavation, screening for MEC, and collection of additional confirmation samples will continue until it is confirmed that MEC has been removed and cleanup levels have been met or until groundwater is encountered.

In the event that groundwater is encountered and a floor sample cannot be collected, a linear five-point composite sample will be collected from each excavation sidewall just above the groundwater interface to represent the floor area above the groundwater. If the linear five-point composite sidewall sample is above the cleanup level, then additional excavation of the sidewall will be conducted to the groundwater interface depth, and over-excavation step outs and confirmation sampling will continue until it is confirmed that MEC has been removed and cleanup levels have been met. The confirmation samples will confirm that the vadose zone soil identified as exceeding the cleanup levels are removed.

Confirmation sample results will be acceptable when below the screening levels for DNT; 2,6-DNT; and TNT as listed in Worksheet #15a with concurrence from the regulatory agencies before backfilling. Figures depicting excavation progress and confirmation sample results will be provided daily during field activities to facilitate approvals and decision making.

Post-detonation confirmation samples will be collected at any location where MEC is detonated for disposition to determine the need for soil removal. Sampling will consist of the collection of composite samples (seven aliquots) at the detonation location at intervals of 0 to 6 inches and 6 to 12 inches. Samples will be analyzed for post-detonation analytes and results will be compared to post-detonation analyte screening criteria (see Worksheet #15a). If a post-detonation confirmation sample result exceeds screening criteria for one or more constituents analyzed, additional soils will be removed and the detonation location resampled until screening criteria are achieved.

Composite samples will additionally be collected from the soil surface in all soil management areas (e.g., former stockpile areas, sift plant area) following completion of operations and off-site disposition of soils. These sample results will be evaluated following the confirmation sampling/analysis methodology described in the RD/RAWP (Bhate, 2019).

Table 17-2: Summary of Confirmation Sampling Defining Excavation Extents

Excavation Area	Excavation Depth (ft)	Existing Sidewall Samples from 2018 PDI[1]	Existing Floor Samples from 2018 PDI[1]	Samples Collected in 2019	Over-Excavation Needed	Additional Samples Required as per Summary Text/Figures
H	2.5–7	17SS24 and 17SS89	17SS21A (7'), 17SS22A (3'), and 17SS25A (7')	17FL003-03-190822, 17FL004-03-190823, 17FL007-03-190822, 17FL008-03-190822, 17FL009-03-190918, 17FL011-03-190926, 17FL015-07-190926, 17WL009-03-190918, 17WL011-03-190822,	700 sq ft along the eastern edge; The north end of the east wall need to be over-excavated approximately 5 ft and the south end of the east wall needs to be over-excavated approximately 10 ft to the east to reach the original excavation extents and the central floor area	5 – floor, north and east sidewall and potentially a south wall or the eastern portion if the floor is deepened an additional 2 ft adjacent to Area K
J	5.5–7.5	17SS90	17SB03 (7.5'), 17SS29A (5.5'), and 17SS91 (5.5')	17WL014-7.5-190926, 17WL015-5.5-190926	approximately 1,250 sq ft in the southeastern portion of the area	south wall
K	2.5	17SS28 and 17SS109 (17SS83 just beyond northern boundary)	17SS27A (2.5'), 17SS84 (2.5'), 17SS85 (2.5'), 17SS86 (2.5'), 17SS87 (2.5'), 17SS88 (2.5 and 17WW01A (2.5')	17WL018-2.5-190918 (south wall)	15 ft lateral to the east (2.5 ft bgs)	wall east
L	2.5–5	17SS97 and 17SS98	17SB04A (5'), 17SS92 (5'), 17SS93 (2.5'), 17SS94 (2.5'), and COE17-08A (2.5')	17WL021-2.5-190918,	west and north walls is required a distance of 5 ft laterally and 2.5 ft vertically	2 – north & west walls
M	2.5 - 7.5	17SS104	17SS103 (2.5'), 17SS105 (2.5'), and 17SB06A (7.5')	17WL022-2.5-190923 exceeds cleanup value for north wall but will be resampled without over-excavation	north, west, south, and deeper bench	4 – sidewall (north, west, south, and composite of deeper bench)
N	2.5–4	17SS104	COE17-16A (4') and 17SS108 (2.5')	17WL026-2.5-190923, 17WL027-2.5-190923	Over excavation – south wall and shallow excavation floor	south sidewall and 1 floor
					Total # Samples to be Collected (minimum)	**13 sidewall and 6 floor**

[1] *Draft Final Pre-Design Investigation Report, LHAAP-17 Burning Ground No. 2/Flash Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas* (PDI) (APTIM 2018).

17a.6.4 Definable Feature of Work 6, Work Element 4: Installation of Groundwater Extraction System Components

Extraction pumps will be installed in wells 17WW02 and 17WW06. An extraction pump may additionally be installed in well 17WW01, as determined by the results of sampling completed IAW the IWWP (Bhate, 2018). Well 17WW01will be sampled and evaluated for use as soon as it is made safely accessible during the TCRA and an extraction pump installed as needed based on sample results. Prior to the extraction pump placement in the wells, groundwater levels will be measured to determine the depth of installation of the pump to get maximum extraction rate. In general, the bottom of the pump will be set at least two feet from the bottom of the well. The pump will be equipped with cycle counters to measure the amount of groundwater recovered from each well. The wellhead assembly will be housed in a 4-foot by 4-foot steel vault and will be equipped with a sample port to allow collection of a sample directly from water produced by the well. The extraction pumps will be operated by compressed air supplied by a compressor located on site. The air compressor will be housed in a building to protect from the elements. The air compressor will be powered by a generator or an electric drop from the power lines along Avenue Q near the entrance to the site.

The extraction piping will be of SDR 11 high density polyethylene pipe (HDPE) and will be buried at least 18 inches below ground. A walk behind trencher will be used to lay the piping underground. A certified HDPE pipe welding technician will perform the welding of the pipe. The trenches will be backfilled and compacted once the pipe is placed. The extraction piping from each well will be connected to manifold and to the holding tank. The discharge pipe from the holding tank will be PVC piping and will run above ground to the transfer pump before being buried and connected to the existing conveyance line coming from LHAAP-16 feeding into the LHAAP-18/24 GWTP. Backflow preventers will be installed as needed to prevent cross flow to or from LHAAP-16. The piping layout is shown on **Figure 7-1**.

The 2,500-gallon dual wall HDPE tank will be installed and anchored to concrete pad approximately 10 feet by 10 feet by 4 inches thick, with two layers of weld mesh. The holding tank will be equipped with an auto shut off system to prevent overflow of the tank. The tank will also have a transfer pump activated by level sensors to transfer water to the GWTP. The location of the tank is shown in **Appendix J**.

17a.6.4 Definable Feature of Work 6, Work Element 5: Staging of Soil

Following the successful screening of stockpiled and excavated soil, the soil material will be staged for off-site disposal at two locations, “overs” will be staged at the MPPEH processing area, and “fines” will be staged in the sifting plant area. The soil may be staged on plastic sheeting awaiting off-site disposal. The soil stockpiles will be protected from rainfall runoff and erosion by covering with 6 mil plastic sheeting or Soiltac. Soiltac is a Soilworks product that will prevent stockpiles from becoming too wet for sifting. It is traditionally used to stabilize and solidify any soil or aggregate as well as erosion control and dust suppression that breaks apart and crumbles with a loader or hand shovel for soil sifting and will not compromise the disposal as non-hazardous waste.

Soil will be transported to and disposed at Waste Connections East Texas Regional Landfill in Henderson, Texas, where soil from LHAAP-17 was previously transported to and disposed of. The stockpiled soil will be sampled and analyzed to support waste profiling, as needed.

17a.7 Definable Feature of Work 7: Munitions and Explosives of Concern/Material Potentially Presenting and Explosive Hazard Disposition

All recovered material will be subjected to a MPPEH inspection, certification, and verification process IAW DoDI 4140.62 (DoD, 2019), EM 385-

1-97 (USACE, 2015), and MEC SOP 18-06 prior to off-site disposition. All metallic debris and “overs” recovered from the sifting operation will be managed as MPPEH and transported by remotely operated EMM to the MPPEH processing area (**Figure 17-1**) for inspection, certification, and verification. The remotely operated EMM will be used to spread material for inspection. Inspection of metallic debris will be visual. Inspection of “overs” will be an instrument-assisted visual inspection (i.e., an all-metals hand-held detector will be used to facilitate the inspection process).

MPPEH processing will result in the segregation and collection of non-metallic miscellaneous debris such as rocks, roots, etc.; NMRD; munitions-related metallic debris absent of explosive hazard termed MDAS; and MDEH. Non-metallic miscellaneous debris will be disposed of off-site with soil “fines.” NMRD will be drummed and recycled off-site by Waste Connections East Texas Regional Landfill. MDAS will be certified and verified as free of explosives hazard, drummed, and transported off-site as described in **Section 17a.7.2**. Other debris will be disposed off-site with the “fines.”

<u>Documentation:</u> All MPPEH will be assessed and its explosives safety status determined and documented in field logbooks and the SUXOS-maintained MEC Control log. Determination of no explosive hazard (i.e., MDAS) inspection will be documented in field logbooks by the UXO TL prior to transfer to the MDAS staging/processing location and certified and verified by the SUXOS and UXOSO/UXOQCS prior to placement in the lockable storage container, planned to be located within LHAAP-17. See Worksheet #29 for project documentation details.

17a.7.1 Definable Feature of Work 7, Work Element 1: Munitions of Explosives of Concern/Material Documented as an Explosive Hazard Demolition

All identified MEC/MPPEH recovered during the TCRA will be inspected by the SUXOS and UXOSO/UXOQCS and determined safe to move. If safe to move, MEC/MDEH will be securely stored in the Type 2 magazine until disposal. Any MEC items, which are deemed unacceptable to move and store by the SUXOS and UXOSO, will be disposed of on the day of discovery or guarded until it can be safely blown in place.

The final explosives safety status of discovered MEC/MDEH will be made by the SUXOS and UXOSO/UXOQCS. MEC disposal operations will be supervised by the SUXOS and coordinated with the on-site OESS. The UXOSO/UXOQCS will ensure that appropriate minimum separation distances for non-essential and essential personnel are properly established and maintained IAW the approved ESS.

All MEC/MDEH disposal operations will follow the procedures outlined in EM 385-1-1 and EM 385-1-97 (USACE, 2013) and will be safely performed IAW MEC SOP 18-04-. Transportation of explosives will be conducted IAW applicable sections of 49 CFR Part 397, EM 385-1-97 (USACE, 2013), U.S. Air Force (USAF) and LHAAP regulations, and the EMP (Appendix C).

MMG-TLI JV will use a local explosives vendor on an as-needed basis to provide donor explosives. Where permitted, sandbag mitigation and/or the Buried Explosion Module (version 7.1) may be used as engineering controls to reduce the intentional detonation maximum fragmentation distance (MFD).

On days when MEC/MPPEH is discovered, the SUXOS will notify the onsite OESS, the USACE TM, USAEC ERM, and BRAC Site Manager and provide a description of the item(s) and potential hazards, current location and status, and anticipated day for disposal/demolition. Once the disposal/demolition date is established, notifications will be made to the Sheriff, Fire Department, USFWS and the Tyler Regional Office. The BRAC Site Manager will assist in coordinating with security, safety, and other relevant LHAAP personnel on any potential impacts to ongoing operations.

Documentation: All MEC/MDEH will be accounted for in the MEC Control Log and SUXOS Daily Report and captured in the Project Database. The log will include the northing and easting, date discovered, grid, specific target identifier, nomenclature, depth of munition, type of munition, photograph number, and disposal date. Donor explosives received, used, and returned will be properly documented in Explosives Accountability records. See Section Worksheet #29 for project documentation details.

17a.7.2 Definable Feature of Work 7, Work Element 2: Material Documented as Safe Disposition

All MPPEH will undergo a preliminary inspection in the grid where it is recovered to determine its explosives safety status and will undergo a 100% inspection and independent 100% re-inspection. All MDAS and other non-munitions-related metallic debris will be stored in separate, secured containers located at LHAAP-17. MDAS will be managed as outlined in DoDI 4140.62, EM 385-1-97 (USACE, 2013), and MEC SOP 18-06. MDAS containers will be sealed and transported to Timberline Environmental Services in Twain Harte, California, a USACE-approved subcontractor who will provide a Certificate of Destruction. Bonetti Explosives of Columbus, Texas, will dispose of MDAS.

Documentation: The explosives safety status of all MDAS will be documented in the TL's field logbook before being moved to an MDAS staging/processing point planned to be located within the LHAAP-17 boundary. DoD Form 1348-1A, *Issue Release/Receipt Document*, will be used as the chain of custody documentation for each container of MDAS and will include dual signatures of the certifier (first 100% inspection) and the verifier (second 100% inspection). The SUXOS will serve as certifier and the OESS (or UXOSO/UXOQCS or similarly trained UXOT designee in the absence of the OESS) will serve as verifier. A Certificate of Destruction will be issued by Timberline Environmental Services when MDAS demilitarization is complete. See Worksheet #29 for project documentation details.

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UFP QAPP Worksheet #17b: Sampling Design and Rationale for Munitions Constituents
(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

17b.1 Definable Feature of Work 8: Sample Collection

MC samples will be collected at all locations within LHAAP-17 where MEC is recovered. Sampling will consist of the collection of a total of ten (10) discrete soil samples at each location where MEC is removed to confirm the source of MC is MEC and to determine the need for hotspot removal. Two (2) discrete soil or sediment samples will be collected, one (1) from 0 to 6 inches and one (1) from 6 to 12 inches directly beneath the removed MEC item. Discrete soil samples will also be collected from 0 to 6 inches and 6 to 12 inches in the four cardinal directions (north, south, east, and west) from the location where the MEC was removed.

MC samples will be collected at any location where MEC is detonated for disposition to determine the need for soil removal. Sampling will consist of the collection of composite samples (seven aliquots) at the detonation location at intervals of 0 to 6 inches and 6 to 12 inches.

Worksheet #18 identifies the proposed analyses for each sampling situation by type. Worksheet #15 identifies the individual analytes and associated comparison criteria (i.e., TCEQ GWP-Ind MSCs Industrial Soil and Screening Criteria).

Laboratory services will be provided by SGS and backup by ALS. The Team will conduct chemical data review and validation IAW the currently approved and implemented DoD Quality Systems Manual (QSM), method requirements, and the project-specific UFP-QAPP.

Documentation: The full analytical data packages will be supplied by the laboratory in PDF format (Level II data packages will be provided in project reports, and Level IV data packages will be uploaded to the Administrative Record). Minimum reporting requirements will be as defined in the DoD QSM, version 5.3 or the currently approved and implemented version if updated. The data will be submitted electronically to the Army and USACE as a Staged Electronic Data Deliverable (SEDD) 2a EDD.

17b.2 Definable Feature of Work 9: Investigation-Derived Waste Management

In addition to the analyses completed for the TCRA, additional sampling may be required for proper management of IDW. The only IDW expected to be generated during this TCRA is decontamination water. A single aqueous IDW sample (analyzed for perchlorate, explosives and metals) is included for characterization of decontamination waters associated with reusable sampling equipment (if any). All IDW will be handled/managed IAW SOP 02-04, *Management of IDW*; SOP 13-02, *Waste Sampling and Analysis Procedures-Drum or Container Sampling and Analysis Procedures*; MEC SOP 18-06, *MEC- MPPEH and Other Debris Management*; and MEC SOP 18-04, *Explosive Demolition for Disposal of Munitions,* as applicable.

Documentation: IDW will be documented in a Waste Tracking Log and sample results and disposition will be discussed in the RACR. See Worksheet #29 for project documentation details.

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UFP-QAPP Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

SAMPLE LOCATION	SAMPLE ID	MATRIX	DEPTH (FEET BGS)	TYPE	ANALYTE/ METHOD/SOP	LOCATION NOTES
Recovered MEC	LHAAP17-SS-D-01	Soil	0–6 inches from below the centroid of recovered MEC	Discrete	Explosives constituents by USEPA Method 8330B Perchlorate by USEPA Method 6850	• Samples will be collected following MEC removal. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.
Vertical Delineation	LHAAP17-SB-D-02	Soil	6-12 inch increment from below the recovered MEC	Discrete	Explosives constituents by USEPA Method 8330B Perchlorate by USEPA Method 6850	• As required. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.
Horizontal Delineation	LHAAP17-SS-D-01N/01S/01E/01W	Soil	12 inches from centroid of recovered MEC in the four cardinal directions (N, S, E, W)	Discrete	Explosives constituents by USEPA Method 8330B Perchlorate by USEPA Method 6850	• Samples will be collected following MEC removal. • Samples will be numbered sequentially consistent with the centroid sample and will indicate the direction (N, S, E, W). • QC samples will be IAW Worksheet #20.

SAMPLE LOCATION	SAMPLE ID	MATRIX	DEPTH (FEET BGS)	TYPE	ANALYTE/ METHOD/SOP	LOCATION NOTES
MEC Demolition Locations	LHAAP17-SS-Demo-CS-01	Soil	0–6 inches below the detonation location	Composite	Explosives constituents by USEPA Method 8330B Perchlorate by USEPA Method 6850	• Sample collected following MEC/MPPEH detonation. • Number of samples dependent on number of detonation locations, if any. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.
MEC Demolition Locations	LHAAP17-SB-Demo-CS-02	Soil	6-12 inches below the detonation location	Composite	Explosives constituents by USEPA Method 8330B Perchlorate by USEPA Method 6850	• Sample collected following MEC/MPPEH detonation. • Number of samples dependent on number of detonation locations, if any. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.
Excavation Verification - Floor	17FL001-2.5-310905[1]	Soil	Varies	Discrete	DNT; 2,6-DNT; and TNT by USEPA Method 8330B	• Sample collected in excavation floor. • Number of samples dependent on number of samples needed to verify cleanup criteria are met. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.

SAMPLE LOCATION	SAMPLE ID	MATRIX	DEPTH (FEET BGS)	TYPE	ANALYTE/ METHOD/SOP	LOCATION NOTES
Excavation Verification - Wall	17WL001-2.5-210905[1]	Soil	Varies	Discrete	DNT; 2,6-DNT; and TNT by USEPA Method 8330B	• Sample collected in excavation wall. • Number of samples dependent on number of samples needed to verify cleanup criteria are met. • Samples will be numbered sequentially. • QC samples will be IAW Worksheet #20.

[1] Sample ID nomenclature consistent with 2019 sampling event.

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UFP-QAPP Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times (UFP-QAPP Manual Section 3.1.2.2) (EPA 2106-G-05 Section 2.3.2)

Laboratory: SGS North America, Inc. – Orlando, 4405 Vineland Road, Suite C-15, Orlando, FL, Jean Dent-Smith, 407-425-6700 x 32811, jean.dent-smith@sgs.com

Back-Up Laboratory: ALS Environmental, 10450 Stancliff Road, Houston, TX 77099, Sonia West, 281-575-2132, Sonia.West@ALSGlobal.com

Required Accreditations/Certifications: National Environmental Laboratory Accreditation Program (NELAP) and DoD Environmental Laboratory Approval Program (ELAP) Accreditations (included in Appendix E). Sample Delivery Method: Federal Express, courier, or hand deliver.

Analyte/ Analyte Group	Matrix	Method/ SOP	Laboratory/ Accreditation Expiration Date[A]	Container (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turn-around
Explosives	Soil	8330B/ GC 034.9	SGS Orlando, TX/NELAP expires 05-31-21/ELAP expires 12-15-2021	One 8oz amber glass jar	≤6 degrees Celsius (°C)	14 days	40 days	15 business days
Perchlorate	Soil	6850/ MS 013.7	SGS Orlando, TX/NELAP expires 05-31-21/ELAP expires 12-15-2021	One 4oz amber glass jar filled 2/3 of the way to prevent anaerobic degradation	≤6 °C	NA	28 days	15 business days

Notes:

[a] Accreditation certificates will be verified prior to submitting samples for analysis and any updated accreditation certificates will be provided with the final report..

[b] Explosives samples and sample extracts should be stored in the dark and refrigerated.

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UFP-QAPP Worksheet #20: Field Quality Control Summary
(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Analyte/ Analytical Group	FD Frequency	MS/MSD Frequency	Field Blanks [a]	Equipment Blanks [b]	Trip Blanks [c]
Soil (discrete and composite)	Explosives	10% (1 FD per 10 field samples)	5% (1 MS/ MSD per 20 field samples)	0	1/day	0
Soil (discrete and composite)	Perchlorate	10% (1 FD per 10 field samples)	5% (1 MS/ MSD per 20 field samples)	0	1/day	0

Notes:

[a] The use of field blanks as a part of this investigation is not appropriate given the nature of the contaminants (explosives and perchlorate) and the media being sampled (non-aqueous). Note that typically field blank use is most applicable when collecting samples for VOC analysis or when aqueous samples are being collected.

[b] Not required if disposable sampling equipment is employed.

[c] No analysis for volatile compounds and ambient contamination in air not anticipated. Therefore, trip blanks will not be submitted for analysis.

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UFP-QAPP Worksheet #21: Field Standard Operating Procedures
(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

SOP Number or Reference [a]	Title, Revision, Date	Originating Organization
MEC SOPS		
MEC SOP 18-01	MEC Anomaly Avoidance, current version	TLI
MEC SOP 18-02	Surface Clearance Operations, current version	TLI
MEC SOP 18-03	Intrusive Operations, current version	TLI
MEC SOP 18-04	Explosive Demolition for Disposal of Munitions, current version	TLI
MEC SOP 18-05	Explosives Management, current version	TLI
MEC SOP 18-06	MPPEH and Other Debris Management, current version	TLI
Geophysical SOPS		
GEO-1a	Global Positioning System, 6/06/2019	AECOM
GEO-1c	Fiducial Positioning, (Date to be determined [TBD*])	AECOM
GEO-2a	Assemble the Single Coil EM61 and Verify Correct Operation, 6/06/2019	AECOM
GEO-3	Establish IVS and Test EM61 Sensor and System, 6/06/2019	AECOM
GEO-4	Production Area Seeding, 6/06/2019	AECOM
GEO-5a	Perform Dynamic Surveys with EM61 cart, (Date TBD*)	AECOM
GEO-6	Process Dynamic Survey Data with EM61, 6/06/2019	AECOM
GEO-7	Field Notes for EM61, 6/06/2019	AECOM
GEO-8	Anomaly Stakeout, 6/06/2019	AECOM
GEO-9	Reacquisition, 6/06/2019	AECOM
GEO-10	Anomaly Resolution, 6/06/2019	AECOM

SOP Number or Reference [a]	Title, Revision, Date	Originating Organization
Sampling SOPs		
SOP 02-03	Field Procedures—Equipment Decontamination, Current Version	TechLaw
SOP 02-04	Field Procedures—Management of Investigation Derived Waste, Current Version	TechLaw
SOP 02-05	Field Procedures—Chain of Custody, Current Version	TechLaw
SOP 03-01	Field Documentation Procedures—Maintaining a Field Logbook, Current Version	TechLaw
SOP 03-02	Taking and Documenting Photographs	TechLaw
SOP 04-02	Packaging and Shipping Procedures—Environmental Samples, Current Version	TechLaw
SOP 07-03	Soil/Sediment Sampling and Analysis Procedures—Surface/Near Surface Soil Sampling, Current Version	TechLaw
SOP 07-07	Soil/Sediment Sampling and Analysis Procedures—Soil, Soil Gas, and Groundwater Sampling Using Direct Push Technology (DPT), Current Version	TechLaw
SOP 13-02	Waste Sampling and Analysis Procedures—Drum or Container Sampling and Analysis Procedure, Current Version	TechLaw
Remote Operations SOPs		
RFI SOP No. 13	Remote Operations: Set Up, Operation, Shut Down, Revision 1, Date, May 14, 2016	Robotics Fabrication, Inc.(RFI)
RFI SOP No. 14	Heavy Equipment Operation, Revision 0, Date, September 14, 2016	RFI
RFI SOP No. 15	Sifting Operations, Revision 1, Date, May 2, 2017	RFI

Notes:
[a] SOPs are provided in Appendix F.

UFP-QAPP Worksheet #22: Equipment Testing, Inspection, and Quality Control
(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

Table 22-1. Site Preparation

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Vegetation clearance: Verification (all clearance mechanisms)	DFW 3, Work Element 1	MEC SOP 18-01	Random locations at frequency of 1 per acre	Project QC/ Surface Sweep Technical Memorandum/ Lead Organization or designee	All vegetation removed to height of 6 inches above the ground surface not to exceeding 6 ft; No obstacles (e.g. felled trees or limbs) remain	RCA/CA; re-verify
Vegetation clearance: Verify correct assembly (mechanized) (1 of 2)	DFW 3, Work Element 1	MEC SOP 18-01	Once following assembly	Field TL/ Instrument Assembly Checklist/ QC Geophysicist	As specified in Assembly Checklist	RCA/CA: Make necessary adjustments, and re-verify
Vegetation clearance: Verify correct deployment (mechanized) (2 of 2)	DFW 3, Work Element 1	MEC SOP 18-01	Daily prior to operations	Field TL/ DQCR/ UXOQCS, UXOSO	Deck height is set to 6 inches above ground surface	RCA/CA: Make necessary adjustments and re-verify

Table 22-1. Site Preparation

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Construct IVS: Verify as-built IVS against design plan (digital sensors)	DFW 1, Work Elements 3,4	GEO-3	Once following IVS construction	Project Geophysicist/ IVS Technical Memorandum/ Lead Organization	Two small Schedule 80 ISO seed items buried at 15 cm: one ISO seed buried horizontally in the cross-track orientation and one buried vertically	RCA/CA: Make necessary changes to seeded items and re-verify
Construct ITS: Verify as-built ITS against design plan (analog sensors)	DFW 1, Work Elements 3,4	MEC SOPs 18-01 18-02 18-03	Once following ITS construction	UXOQCS	Small ISO seed items for analog methods buried at 30 cm; all seeds buried horizontally in the cross-track orientation	RCA/CA: Make necessary changes to seeded items and re-verify
Verify correct assembly (all sensors)	DFW 1, Work Elements 3,4	GEO-2a	Once following assembly	Field TL/ Instrument Assembly Checklist/ Project Geophysicist	As specified in Assembly Checklist	RCA/CA: Make necessary adjustments and re-verify
Initial Instrument Function Test (EM61)	DFW 1, Work Elements 3,4	GEO-2a	Once following assembly	Field Geophysicist/ Initial IVS Memorandum/Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response	RCA/CA: Make necessary adjustments, and re-verify

Table 22-1. Site Preparation

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Initial/Ongoing Instrument Function Test (analog)	DFW 1, Work Elements 3,4	MEC SOPs 18-01 18-02 18-03	Once upon arrival at project site and daily when instruments are used for avoidance and surface sweep	UXO TL/ITS scoresheet/UXOQCS	Audible response consistent with expected change in tone in presence of standard object	RCA/CA: Make necessary adjustments, and re-verify
Initial detection survey positioning accuracy (IVS) (EM61)	DFW 1, Work Elements 3,4	GEO-3	Once prior to start of data acquisition	Project Geophysicist/IVS Memorandum/QC Geophysicist	Derived positions of IVS target(s) are within 25 cm of the ground truth locations	RCA/CA: Make necessary adjustments and re-verify
Initial detection survey Check for interference surrounding seed response (IVS) (all sensors)	DFW 1, Work Elements 3,4	GEO-3	Once prior to start of data acquisition	Project Geophysicist/ IVS Memorandum/ QC Geophysicist	All seeds placed in locations that are free of detected anomalies within a radius of ≥1.5 m	RCA/CA and re-verify MQO

Table 22-2. Preliminary Detection Survey

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Ongoing detection survey positioning precision (IVS) (digital)	DFW 1, Work Elements 3, 4	GEO-1b, GEO-4, GEO-6	Beginning and end of each day	Project Geophysicist/Running QC Summary/ QC Geophysicist	Derived positions of IVS target(s) within 25 cm of the average locations	RCA/CA
In-line measurement spacing (EM61)	DFW 1, Work Elements 3, 4	GEO-6	Verified for each grid using Geosoft oasis UCEDATASEP GX	Project Geophysicist/Running QC Summary/ QC Geophysicist	98% ≤ 0.25 m between successive measurements; 100% ≤1.0 m; coverage gaps are filled or adequately explained (e.g., unsafe terrain)	RCA/CA
Battery voltage (DGM)	DFW 1, Work Element 4	SOP GEO-5a	Verify battery voltage is within operating specifications of sensor	Field TL/ Running QC Summary/ Project Geophysicist	Voltage must be ≥ 11.0 V	RCA/CA: Out of spec data rejected

Table 22-3. Detection Survey and Intrusive Activities

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Surface Sweep: Documenting recovered surface MEC and debris within grids (all sensors)	DFW 3, Work Elements 3	MEC SOPs 18-02	Daily	UXOQCS/ GIS data recorded/ Project QC or designee	All metallic debris collected is counted and documented in the project database for the following attributes: Designation as UXO, DMM, MD, or NMRD; and UXO and MD described by type, weight, and as TOI or non-TOI. Photos displaying all MD recovered (individual MD photos not necessary) and photos showing all surfaces of each MEC/TOI are recorded.	RCA/CA: Document questionable information in database; justify safety concerns
Surface Clearance QC Seeding	DFW 3, Work Element 3	MEC SOPs 18-02	Minimum of 1 seed per lot placed on the surface. A Lot equals 1 grid or 100 ft x100 ft.	Surface Clearance Team/ Project database/UXOQCS	Must have 100% recovery of verification seeds per Lot.	RCA/CA: Make necessary adjustments, and re-verify
Geodetic Equipment Functionality (RTK GPS)	DFW 1, Work Elements 3,4	GEO-1a	Daily (RTK GPS)	Field TL/ GIS data recorded/ Project QC or designee	Measured position of control point within 10 cm of ground truth	RCA/CA: Document questionable information in database

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Geodetic Accuracy (confirm valid position)	DFW 1, Work Elements 3,4	GEO-1a GEO-6	Evaluated for each measurement	Field TL/ GIS data recorded/ Project QC or designee	GPS status flag indicates RTK fix (RTK GPS);	RCA/CA: Document questionable information in database
Vegetation Clearance Inspection (all sensors)	DFW 3, Work Element 1	MEC SOP 18-01	Random locations at frequency between four and twelve per acre	Project QC Geophysicist/ Surface Sweep Technical Memorandum/ Lead Organization	All vegetation removed to ≤15 cm; all trees less than 6 inches in diameter at breast height are removed; no obstacles (e.g. felled trees or limbs) remain	RCA/CA and re-verify
Ongoing Instrument Function Test (DGM)	DFW 5, Work Element 1	GEO-3	Beginning and end of each day	Field TL/ Running QC Summary/ Project or QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response	RCA/CA: Make necessary repairs and re-verify
In-line measurement spacing (EM61)	DFW 5, Work Element 1	GEO-6	Verified for each grid using Geosoft oasis UCEDATASEP GX	Project Geophysicist/Running QC Summary/QC Geophysicist	98% ≤ 0.25 m between successive measurements; 100% ≤1.0 m	RCA/CA: Coverage gaps are filled or adequately explained (e.g., unsafe terrain)
Coverage (EM61, grids)	DFW 3, Work Element 5	GEO-6	Verified for each grid using Geosoft oasis UCEFOOTPRINTCOV GX	Project Geophysicist/ Running QC Summary/ QC Geophysicist	100% of specified acreage is sampled at the calculated lane spacing (0.8 m)	RCA/CA: Collect additional data to increase coverage percentage to meet acceptance criterion

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Detection survey performance (EM61)	DFW 3, Work Element 5	GEO-4	Average one blind QC seed per instrument per day; seeds to be placed throughout expected detection depth range	QC Geophysicist/ Running QC Summary/ Lead Organization QA Geophysicist	90% of blind QC seeds must be detected and positioned within 65 cm and 100% within 75cm of ground truth	RCA/CA: Verify instrument is functioning correctly; if so, reduce threshold or determine if item is buried too deep. If instrument is not functioning correctly, recollect data.
DGM grid resolution of targets	DFW 5, Work Element 2	MEC SOP 18-03	Rate varies depending on lot size per EM200-1-15 Table 6-6: Acceptance Sampling Table for Anomaly Resolution	UXOSO/UXOQCS/ DQCR/USACE QA	90% confidence < 1% unresolved anomalies. Accept on zero.	Where the source of the failed response, verify documentation and notification; otherwise, perform RCA and CA
DGM grid detection and recovery of QC seeds	DFW 5, Work Element 2	MEC SOP 18-03	Daily	Intrusive Teams/Project Database/UXOQCS	Recovery of 100% of QC seeds	Perform RCA and CA

MQO	DFW-Work Element-Sub-Element	Applicable SOP(s)	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Achieve Excavation and Installation of Groundwater Extraction System Components – Excavation complete	DFW 6 Work Element 2, 3	N/A	When performed	HTRW Technical Lead/Field Forms	Verification sample results below screening criteria	Continue excavation
Achieve Excavation and Installation of Groundwater Extraction System Components – Groundwater Extraction System Components Installed	DFW 6 Work Element 4	N/A (RD/RA WP)	When performed	HTRW Technical Lead/Field Forms	Visual verification of installation per RD/RA WP	Identify cause of non-conformance and redo affected work
MEC/MPPEH disposition – MEC/MDEH demolition complete destruction	DFW 7, Work Element 1	MEC SOP 18-04	Following each demolition event	SUXOS and Demolition TL/Field Forms/ UXOSO/UXOQCS	No energetic materials remain	Identify cause of incomplete destruction, perform cleanup shot to dispose of all identified kick outs

MQO	**DFW-Work Element-Sub-Element**	**Applicable SOP(s)**	**Frequency**	**Responsible Person/Report Method/ Verified by:**	**Acceptance Criteria**	**Failure Response**
MEC/MPPEH disposition – MDAS disposition field operation verification	DFW 7, Work Element 2	MEC SOP 18-06	When performed	SUXOS/Demolition TL/Field Logbook and MEC Control Log/UXOSO/UXO QCS	No energetic item(s) classified as MDAS	Identify cause of misidentification (if applicable) and redo affected work
MEC/MPPEH disposition – MDAS disposition field operation verification	DFW 7, Work Element 2	MEC SOP 18-06	Daily when MD is recovered	SUXOS/Field logbook and forms 1348-1A/ UXOSO/UXOQCS	All MDAS secured and separated; documents prepared and signed	Re-inspect all material in lockable container

UFP-QAPP Worksheet #23: Analytical Standard Operating Procedures
(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

SOP #	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Primary Laboratory – SGS Orlando					
GC 034.9	Analysis of Nitroaromatics, Nitramines, and Nitrate Esters by HPLC Method SW-846 8330B, 10/2019	Definitive Data	Soil/Explosives	HPLC	N
OP046.7	Standard Operating Procedure for the Extraction of Nitroaromatics and Nitramines from Solid Samples for HPLC Analysis By SW-846 8330B. ISM Samples via Ring and Puck Mill Discreet Samples via Mortar and Pestle, 04/2020	Definitive Data	Soil/Explosives	NA	N
ORLD-SAM-101-20-SOPT	Sample Receipt and Storage,	Definitive Data	NA	NA	N
MS 013.7	Analysis of Perchlorate by LC/MS/MS, 08/2019	Definitive Data	Soil/Perchlorate	NA	N

Notes:
Analytical SOPs and laboratory Quality Assurance Manual (QAM) are included in Appendix E

UFP-QAPP Worksheet #24: Analytical Instrument Calibration
(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
HPLC	Initial Calibration (ICAL)	See SOP	At instrument set-up and after initial calibration verification (ICV) or continuing calibration verification (CCV) failure, prior to sample analysis	ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; or Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Correct problem, then repeat ICAL	Analyst	GC 034.9
HPLC	Retention Time (RT) Window Position Establishment	NA	Once per ICAL and at the beginning of the analytical sequence	The position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	See SOP	Analyst	GC 034.9

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
HPLC	RT Window Width	NA	At method set-up and after major maintenance (e.g., column change)	The RT width is ± 3 times standard deviation for each analyte RT from the 72-hour study.	See SOP	Analyst	GC 034.9
HPLC	ICV	NA	Once after each ICAL, analysis of a second source standard prior to sample analysis	All reported analytes must be within established RT windows. All reported analytes must be within ± 20% of true value.	Correct problem, rerun ICV; if that fails, repeat ICAL	Analyst	GC 034.9

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
HPLC	CCV	NA	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence	All reported analytes and surrogates must be within established RT windows. All reported analytes and surrogates must be within ± 20% true value.	Recalibrate and reanalyze all affected samples since the last acceptable CCV, or immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take CA(s) and re-calibrate, then reanalyze all affected samples since the last acceptable CCV.	Analyst	GC 034.9

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Interference Threshold Study	NA	At initial setup and when major changes occur in the method's operating procedures (e.g., addition of cleanup procedures, column changes, mobile phase changes).	Measure the threshold of common suppressors (chloride, sulfate, carbonate, bicarbonate) that can be present in the system without affecting the quantitation of perchlorate. The threshold is the concentration of the common suppressors where perchlorate recovery falls outside an 80-120% window.	NA	Lab Manager / Analyst	MS 013.7
LC/MS/MS	Mass Calibration	NA	Instrument must have a valid mass calibration prior to any sample analysis. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses show large deviations from known masses, major instrument maintenance is performed, or the instrument is moved).	Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for an analytical run, and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard.	NA	Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Tune Check	NA	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must span the mass range of the analytes of interest and meet acceptance criteria outlined in the laboratory SOP	Retune instrument and verify. If the tune check will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone.	Lab Manager / Analyst	MS 013.7
LC/MS/MS	Minimum six-point initial calibration for target analytes, lowest concentration standard at or below the reporting limit	See SOP	At instrument setup or after ICV or CCV failure, prior to sample analysis.	ICAL must meet one of the two options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.995$.	Correct problem, then repeat ICAL.	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	ICV	NA	Once per six-point initial calibration	Perchlorate within ±15% of the true value	Evaluate data. If problem (e.g., concentrated standard, plugged transfer line) found, correct, then repeat second source verification. If it still fails, then repeat initial calibration.	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	CCV	NA	On days an ICAL is performed, after every 10 field samples, and at the end of the analytical sequence. On days an ICAL is not performed, at the beginning of the sequence, after every 10 field samples, and at the end of the analytical sequence.	Perchlorate within ±15% of the true value	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Laboratory Reagent Blank	NA	Prior to calibration and at the end of the analytical sequence.	No perchlorate detected > 1/2 LOQ	Reanalyze reagent blank (until no carryover seen), and any samples with perchlorate detections since the contaminated blank.	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Isotope Ratio $^{35}Cl/^{37}Cl$	NA	Every sample, batch QC sample, and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Must fall within 2.3 to 3.8	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample must be re-extracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate, e.g., a post spike sample or dilution to reduce any interference.	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Internal Standard	NA	Addition of ^{18}O-labeled perchlorate to every sample, batch QC sample, standard, instrument blank, and Method Blank.	Measured ^{18}O IS area within ± 50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0 ± 2% (0.98 – 1.02).	Rerun the sample at increasing dilutions until the ± 50% acceptance criteria are met. If criteria cannot be met with dilution, the interference is suspected, and the sample must be re-prepped using additional pretreatment steps	Lab Manager / Analyst	MS 013.7

(EPA 2106-G-05 Section 2.3.6) Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	SOP Reference
LC/MS/MS	Interference Check Sample (ICS)	NA	One ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch. It verifies the method performance at the matrix conductivity threshold (MCT). At least one ICS must be analyzed daily. The ICS shall be prepared at the LOQ.	Perchlorate concentration must be within ± 20% of its true value.	Correct problem. Reanalyze all samples and QC samples in the batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.	Lab Manager / Analyst	MS 013.7

Notes:

[a] The analyst initiates the corrective action and the lab manager and analyst are responsible for the CA.

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UFP-QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Title/position responsible for CA	Reference
HPLC	Monitor system pressure, back flush the column, change guard cartridges, change the frit on the front end of the column	Explosives	Monitor system pressure, check for leaks, check guard cartridges	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	GC 034.9
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst / Supervisor	MS 013.7

Notes:
Instrument and equipment maintenance, testing, and inspection information is further discussed in the SOPs and the laboratory QAM, provided in Appendix F.4.

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UFP-QAPP Worksheets #26 & 27: Sample Handling, Custody, and Disposal
(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Section 2.3.3)

Sampling Organization: MMG-TLI JV
Laboratory: SGS Orlando (primary) or ALS Houston (backup)
Method of sample delivery (shipper/carrier): Federal Express, courier, or hand delivery
Number of days from reporting until sample disposal: 90 days

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Field Documentation Procedures – Maintaining a Field Notebook	MC Sampling TL, MMG-TLI JV	SOP 03-01
Field Procedures – Chain of Custody	MC Sampling TL, MMG-TLI JV	SOP 02-05
Packaging and Shipping Procedures – Environmental Samples	MC Sampling TL, MMG-TLI JV	SOP 04-02
Sample receipt, inspection, and login	Primary: SGS / Secondary: ALS	ORLD-SAM-101-20-SOPT Sample Receipt
Sample custody and storage	Primary: SGS / Secondary: ALS	ORLD-SAM-101-20-SOPT Sample Receipt
Sample disposal	Primary: SGS / Secondary: ALS	ORLD-SAM-101-20-SOPT Sample Receipt

Notes:

[a] Field SOPs are provided in Appendix F, Laboratory SOPs are provided in Appendix E.

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UFP-QAPP Worksheet #28: Analytical Quality Control and Corrective Action
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix: Soil (Discrete and Composite) Analytical Group: Explosives Analytical Method/SOP: 8330B/GC 034.9

QC Sample	**Number/ Frequency**	**Method/SOP Acceptance Criteria**	**CA**	**Title/Position of Person Responsible for CA**	**Project-Specific MPC**
MB	One per preparatory batch	No analytes must be detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank.	Analyst	NA
LCS	One per preparatory batch	Accuracy: QSM 5.3, Appendix C, Table C-37 Precision: RPD ≤ 20%	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for the failed reported analytes (if sufficient sample material is available).	Analyst	NA
MS/MSD	One per preparatory batch	Accuracy: QSM 5.3, Appendix C, Table C-37 Precision: RPD ≤ 20%	Examine the project-specific requirements; contact the client as to additional measures to be taken.	Analyst	NA
Surrogates	All field and QC samples	QSM 5.3, Appendix C, Table C-37 or laboratory limits	Correct problem, then re-prep and reanalyze all failed samples for all surrogates in the associated preparatory batch (if sufficient sample material is available). If obvious chromatographic interference with the surrogate is present, reanalysis may not be necessary.	Analyst	NA

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	CA	Title/Position of Person Responsible for CA	Project-Specific MPC
Confirmation of positive results (second column)	All positive results must be confirmed.	Calibration and QC criteria for second column are the same as for initial or primary column analysis. Results between primary and secondary column/detector must have an RPD ≤ 40%.	Report from both columns and discuss in the Case Narrative.	Analyst	NA

UFP-QAPP Worksheet #28b: Analytical Quality Control and Corrective Action
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix: Soil (Discrete and Composite) Analytical Group: Perchlorate Analytical Method/SOP: 6850/MS 013.7

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	CA	Title/Position of Person Responsible for CA	Project-Specific MPC
MB	One per preparatory batch	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Analyst	NA
LCS	One per preparatory batch	Accuracy: QSM 5.3, Appendix C, Table C-36. Precision: RPD ≤ 20%.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for the failed reported analytes, if sufficient sample material is available.	Analyst	NA
MS/MSD	One per preparatory batch	Accuracy: QSM 5.3, Appendix C, Table C-37 Precision: RPD ≤ 20%	Examine the project-specific requirements; contact the client as to additional measures to be taken.	Analyst	NA

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UFP-QAPP Worksheet #29: Data Management, Project Documents and Records
(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Part 1: Data Management Specifications

Computer Files and Digital Data: IAW the Performance Work Statement, MMG-TLI JV will include complete laboratory data PDF files with the final RACR on compact disk(s) (CD). All electronic data submitted by the laboratory will be error-free using the latest version of the project-specific automated data review library (eQAPP) and the latest version of automated data review (ADR) software. EDDs will be verified to be in complete agreement with the hardcopy data reports. Results will be submitted as an EDD in the SEDD format. Data files will be delivered both by e-mail and on high-density (HD) CD accompanying the hardcopy data reports. The disk(s) will be submitted with a transmittal letter from the laboratory that certifies that the file is in agreement with hardcopy data reports. Validated electronic output data in SEDD format will be submitted along with the eQAPP. All chemical data received from the laboratory will be submitted to USACE for archiving. These data will not be submitted on paper. All laboratory reports and data will be submitted on disk and labeled such that the data are identifiable by the project. All laboratory analysis/reports will be organized and submitted as a full data package in PDF format to include original completed chains of custody.

Hard Copies of Required Documents: IAW the Performance Work Statement, MMG-TLI JV will submit deliverables to demonstrate that performance objectives and milestones have been met and that payment is appropriate. MMG-TLI JV will provide electronic copies of all submittals. Electronic copies to the Army will be delivered on labeled CDs and shall include a PDF copy as well as an editable (.docx or .doc) format copy. Electronic copies to the EPA and TCEQ will be submitted as a downloadable PDF. Electronic documents over 10 megabytes in size will be delivered to the USACE, USAEC, and BRAC via labeled CDs and/or via the DoD Safe database website. Smaller files may be submitted via email. MMG-TLI JV will also provide one hard copy each to the USACE TM, USAEC ERM, and BRAC Site Manager POC of all final documents.

Part 2: Control of Documents, Records, and Databases

Table 29-1. Minimum Required Documents and Records

Minimum Required Documents and Records			
Document/Record	**Generation Purpose**	**Completion/ Update Frequency**	**Format/ Storage Location/ Archive Requirements**
Utility clearances	Signatures required to be obtained for utility clearance	Once, prior to work start	Hard copy and electronic/lead vehicle/project file
Personnel qualifications certificates or other verifiable documentation	Documents that required training and/or certifications have been completed or obtained	Prior to mobilization/upon renewal of certifications or training/when new personnel on-site	Electronic/lead vehicle/project file
Record of Training	Documents attendance at training events	As required (when training is provided)	Hard copy or electronic/lead vehicle/project file
Daily Safety Briefing log	Documents that site-specific training has been provided and attended	Daily	Hard copy/lead vehicle/project file
Safety Data Sheets	Provides the characteristics and safety information for hazardous materials brought on site	Prior to mobilization/when new materials are brought on site	Electronic/lead vehicle/project file
Daily Safety Inspection and Weekly Audit Log	Record of health and safety inspections (documents that the site is properly equipped with safety equipment and operations are being performed in compliance with the APP/SSHP)	Prior to field operations kickoff and daily	Hard copy/lead vehicle/project file
Stop Work Order	Documentation of stop work	As needed	Hard copy/lead vehicle electronic/project file
PLS Report (*)	Documents LHAAP-17surveyed boundary	Once	Electronic/project database/project file
Equipment-specific inspection checklists, calibration records, or forms (*)	To verify equipment inspection, calibration, and function checks are conducted and documented	Daily/minimum of weekly	Hard copy/lead vehicle/project file

Minimum Required Documents and Records			
Document/Record	**Generation Purpose**	**Completion/ Update Frequency**	**Format/ Storage Location/ Archive Requirements**
Accident/Incident Reports (OSHA 300, 300A, 301, TLI Incident Reporting Form, USACE 3394)	Record of any accidents/incidents on-site for USACE, OSHA	As required	Electronic/lead vehicle/project file
Visitor Sign-in Sheet	Record of visitors and recognition of non-essential personnel present	As required (when visitors are present on-site)	Hard copy/lead vehicle/project file
SUXOS Daily Report (*)	Overall record of work completed, grid status, explosives inventory, records maintained for Contractor Manpower Reporting per EM 385-1-97	Daily/Weekly	Hard copy or electronic/lead vehicle/archived electronically
DQCRs (*)	Record of QC checks, issues, and the three phases of control (TPC) process	The rates defined in Table 31-2 of Worksheets #31, #32, and #33	Hard copy or electronic/SharePoint or server/project file
IVS Letter Report (*)	Report establishing the mV threshold, demonstrating geophysical systems are operational and capable of performing the work.	Completed following field operations within IVS and submitted to USACE for approval and with Final RACR	Electronic/SharePoint or server/project file
Record of daily ITS and IVS checks (*)	Record of ITS/IVS tests	Daily	Electronic/SharePoint or server/ archived electronically
QC Seed Plan	Plan for QC seeds including size, depth, and orientation, to ensure project objectives will be properly tested.	Before field work begins	Hard copy or electronic / Firewalled by QC Geophysicist until conclusion of field work and then filed with project documents
Seed Tracking Log (*)	Record of location, depth, and orientation of QC blind seeds	During placement prior to DGM	Hard copy and electronic/UXOSO/UXO QCS file/project file

Minimum Required Documents and Records			
Document/Record	**Generation Purpose**	**Completion/ Update Frequency**	**Format/ Storage Location/ Archive Requirements**
Field Data/Grid Sheet (*)	Record of instrument-assisted surface sweep, DGM survey, and/or subsurface removal and inspection; may be used in addition to or in place of tablets	As performed	Hard copy or electronic/lead vehicle/project file
DGM data processing report (*)	Digital record of all DGM data collected	DGM data deliverables for each week's data collection are due by the following Friday.	Digital data files/SharePoint or server/archived electronically
Target Selection Technical Memorandum (*)	Describes the process and rationale for selecting targets from the detection data	Completed after detection data are collected and processed	Digital data files/SharePoint or server/archived electronically
DUAs	Provides assessment of data usability at various stages of project	Completed after each respective stage (DGM survey and subsurface removal/inspection phase of work	Digital data files/SharePoint or server/archived electronically
Updated CSM (*)	CSM updated to reflect results of characterization effort	Following preliminary characterization and again upon project completion	Electronic/SharePoint or server/project file
Subsurface Removal/Inspection Results (*)	Documents the findings of each subsurface removal/inspection to describe the quantity, depth, size, orientation, description of item, and other pertinent data related to the intrusive investigation	Subsurface removal/inspection results will be uploaded to a database following QC review	Digital data files/SharePoint or server/archived electronically
Final CSM (*)	Interpretation of results	Completed following field operations	Electronic/SharePoint or server/project file

Minimum Required Documents and Records			
Document/Record	**Generation Purpose**	**Completion/ Update Frequency**	**Format/ Storage Location/ Archive Requirements**
Project Database (*)	Record of all QC information related to instrument-assisted surface sweep, DGM, reacquisition, and subsurface removal/inspection	DGM data deliverables for each week's data collection are due by the following Friday.	Electronic/SharePoint or server/archived electronically
Field logbooks (*)	Record of field activities for SUXOS, UXOSO/UXOQCS, Project Geophysicist, Project Geologist (or Project Geologist's representative), and designated TL	Daily	Hard copy/lead vehicle/project file
NCAR and NCAR Log (*)	Record of non-conformance activities and NCARs taken	As required (when non-conformance is identified)	Hard copy or electronic/lead vehicle/project file
FCR forms and FCR Log (*)	Record of modifications to approach implemented in the field and documentation of client approval	As required	Electronic/lead vehicle electronic/project file
Photographic Log (*)	Record of activities, site conditions, and observations for MC sampling	As needed	Electronic/SharePoint or server/archived electronically
Chain of Custody (*)	Record of sample custody for MC sampling	During any transfer of custody of sample(s)	Hard copy and electronic/Project Geologists file/project file
MEC Control Log (*)	Record details of all MEC and other MPPEH recovered and disposed	As needed	Hard copy or electronic/lead vehicle/project file
Explosives Accountability records	Record details of all donor explosives received, used, and returned	As needed	Hard copy or electronic/lead vehicle/project file
DoD Forms 1348-1A	Certification that MDAS is free of explosives	As required	Hard copy or electronic/lead vehicle /project file

Minimum Required Documents and Records			
Document/Record	**Generation Purpose**	**Completion/ Update Frequency**	**Format/ Storage Location/ Archive Requirements**
Motor Vehicle Inspection (DoD Form 626)	Safety Inspection for vehicles transporting explosives on-site	As required	Hard copy or electronic/lead vehicle/project file
Waste Tracking Log	Record of IDW generated	Daily	Hard copy or electronic/lead vehicle/project file
RACR Report (*)	Presents results	Completed following field operations	Electronic/SharePoint or server/project file
GIS Data/Deliverable (*)	Maintain spatial data, details for project reporting in the form of mapping and GIS deliverable	Updated monthly/regularly as data is generated; GIS deliverable submitted at the end of the project	Electronic/project file/archived electronically

Notes:

[a] Hard copy field records will be maintained in the MMG-TLI JV lead vehicle for the duration of field activities unless otherwise indicated. Upon completion of the field activities, hard copy records will be scanned into electronic format and maintained in TLI’s Golden, Colorado, office for the contract-required period.

(*) indicates data necessary for Utilization Assessment in WS#37.

UFP-QAPP Worksheets #31, 32, & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA 2106-G-05 Section 2.4 and 2.5.5)

The planned audits and assessments are designed around the TPC QC inspection system documented on the DQCR. USACE QA will conduct independent audits. Most field audits are the responsibility of the UXOSO/UXOQCS. Field teams are observed daily during operations with results documented on tablets (i.e., the Project Database) in field logbooks, SUXOS Daily Reports, DQCRs, and other project forms. The SUXOS will conduct daily observations of the teams, monitor activities, and record the findings in his logbook. A discussion of roles, responsibilities, non-conformance, and document control follows Table 31-3.

For this project, related activities are grouped as DFWs. Some DFWs have multiple aspects or tasks associated within the DFW that will be addressed as part of the DFW TPC process. The TPC process is described below:

Table 31-1: Three-Phases of Control

Three Phase QC Surveillance Program	Description of QC Surveillance Program	Responsible Individuals to Verify Compliance	Responsible Individuals to Validate Compliance
Phase I: Preparatory Phase of Control	A Preparatory Inspection is a compliance inspection performed prior to beginning each task. The purpose of this inspection is to review applicable job specifications and verify that the necessary equipment, personnel, and controls are in place before work activities start. It is attended by all personnel involved in implementation of each specific DFW task. The SUXOS will identify equipment available, verify that plans are in place, and describe in detail the work specifics outlined in the approved UFP-QAPP and ESS. The UXOSO/UXOQCS will address all AHAs pertinent to the project and DFW. The UXOSO/UXOQCS will discuss pass/fail criteria and provide a copy of the specific QC check sheet used to evaluate the task to the SUXOS and TL. The TL and team members will attend. This is where any questions concerning the task, safety equipment, quality standards, SOP, etc., are discussed and agreed on. The Preparatory inspection is documented on a Quality Control 3-Phase Inspection Checklist identifying the phase as Preparatory for the particular task.	UXOSO/UXOQCS, Project Geophysicist, Project Geologist, or designated TL	CQCS or authorized designee

Table 31-1: Three-Phases of Control

Three Phase QC Surveillance Program	Description of QC Surveillance Program	Responsible Individuals to Verify Compliance	Responsible Individuals to Validate Compliance
Phase 2: Initial Phase of Control	An Initial Inspection is performed the first-time work is performed under a task. The purpose of the inspection is to check the preliminary work for compliance with procedures and contract specifications, to establish an acceptable level of workmanship, to check safety compliance, to review the preparatory phase inspection/briefing findings, to check for any omissions, and to resolve differences of interpretation before the task progresses too far. Additionally, the following are checked: • Verify deficiencies identified during the preparatory phase were corrected and implemented. • Verify all equipment is used properly. • Verify quality workmanship is performed and acceptable. The Initial Inspection is documented on a Quality Control 3-Phase Inspection Checklist identifying the phase as Initial for that particular task.	UXOSO/UXOQCS, Project Geophysicist, Project Geologist, or designated TL	CQCS or authorized designee

Table 31-1: Three-Phases of Control

Three Phase QC Surveillance Program	Description of QC Surveillance Program	Responsible Individuals to Verify Compliance	Responsible Individuals to Validate Compliance
Phase 3: Follow-Up Phase of Control	Follow-Up Inspections start immediately after the initial phase QC inspection. They address the routine day-to-day activities of the project. During this phase: • Follow-up phases of control will be performed at the frequency specified in Table 31-2. • The quality of workmanship will be evaluated to ensure it is maintained at or above the levels established during the preparatory/initial phases. • Required equipment testing/checks/procedures will be verified to ensure they are performed correctly IAW procedures established at the preparatory phase and confirmed during the initial phase inspections. • Deficient items identified will be verified to ensure they were corrected/implemented IAW a CA plan. The Follow-Up Inspection is documented on a Quality Control 3-Phase Inspection Checklist identifying the phase as Follow-Up for that particular task.	UXOSO/UXOQCS, Project Geophysicist, Project Geologist, or designated TL	CQCS or authorized designee

Table 31-2: Assessments – Three Phases of Control and Operational Control

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Operational Readiness Review	PM/SUXOS, MMG-TLI JV	Once	One month prior to mobilization	Readiness Review Report	One month prior to mobilization
Site Preparation – Preparatory Phase	UXOSO/UXOQCS, MMG-TLI JV	Once prior to Site Preparation for each task/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Site Preparation	Throughout field activities; refer to Project Schedule
Site Preparation – Initial Phase	UXOSO/UXOQCS, MMG-TLI JV	Once at the beginning of Site Preparation for each task/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Site Preparation	Throughout field activities; refer to Project Schedule
Site Preparation – Follow-Up Phase	UXOSO/UXOQCS, MMG-TLI JV	A minimum of once per week for each active Site Preparation activity/team	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Site Preparation	Throughout field activities; refer to Project Schedule
Instrument-assisted Surface Sweep Grid – Preparatory Phase	UXOSO/UXOQCS, MMG-TLI JV	Once prior to beginning instrument-assisted surface sweep when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Instrument-assisted Surface Sweep	Throughout field activities; refer to Project Schedule
Instrument-assisted Surface Sweep Grid – Initial Phase	UXOSO/UXOQCS, MMG-TLI JV	Once at the beginning of instrument-assisted surface sweep/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Instrument-assisted Surface Sweep	Throughout field activities; refer to Project Schedule

Table 31-2: Assessments – Three Phases of Control and Operational Control

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Instrument-assisted Surface Sweep Grid – Follow-Up Phase	UXOSO/UXOQCS, MMG-TLI JV	Weekly, per surface sweep team	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Instrument-assisted Surface Sweep	Throughout field activities; refer to Project Schedule
Geophysical Survey – Preparatory Phase	UXOSO/UXOQCS, Project Geophysicist/ QC Geophysicist, AECOM	Once prior to beginning DGM or when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Documented in Quality Control 3-Phase Inspection Checklist and Project Database for DGM Field and Processing activities	Throughout field activities; refer to Project Schedule
Geophysical Surveys – Initial Phase	UXOSO/UXOQCS, Project Geophysicist/QC Geophysicist, AECOM	Once at the beginning of DGM or when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Documented in Quality Control 3-Phase Inspection Checklist and Project Database for DGM Field and Processing activities	Throughout field activities; refer to Project Schedule
Geophysical Surveys – Follow-Up Phase	UXOSO/UXOQCS, Project Geophysicist/QC Geophysicist, AECOM	Weekly, per DGM team	Throughout field activities; refer to Project Schedule	Documented in Quality Control 3-Phase Inspection Checklist and Project Database for DGM Field and Processing activities	Throughout field activities; refer to Project Schedule

Table 31-2: Assessments – Three Phases of Control and Operational Control

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Data Management – Preparatory Phase	Project Data Manager, AECOM	Once prior to project data acquisition/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Documented in Project Database	Throughout field activities; refer to Project Schedule
Data Management – Initial Phase	Project Data Manager, AECOM	Once at the beginning of project data acquisition/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Documented in Project Database	Throughout field activities; refer to Project Schedule
Data Management – Follow-Up Phase	Project Data Manager, AECOM	Monthly	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Documented in Project Database	Throughout field activities; refer to Project Schedule
DGM -Grid – Preparatory Phase	UXOSO/UXOQCS, MMG-TLI JV	Once prior to beginning intrusive operations, when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Subsurface Removal/Inspection	Throughout field activities; refer to Project Schedule
DGM -Grid – Initial Phase	UXOSO/UXOQCS, MMG-TLI JV	Once at the beginning of intrusive operations, when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Subsurface Removal/Inspection	Throughout field activities; refer to Project Schedule

Table 31-2: Assessments – Three Phases of Control and Operational Control

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
DGM Grid – Follow-Up Phase	UXOSO/UXOQCS, MMG-TLI JV	Weekly, subsurface removal/inspection team	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – Subsurface Removal/Inspection	Throughout field activities; refer to Project Schedule
MEC/MPPEH Demolition – Preparatory Phase	UXOSO/UXOQCS, MMG-TLI JV	Once prior to MEC/MPPEH demolition/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MEC/MPPEH Demolition	Throughout field activities; refer to Project Schedule
MEC/MPPEH Demolition – Initial Phase	UXOSO/UXOQCS, MMG-TLI JV	Once at the beginning of MEC/MPPEH demolition/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MEC/MPPEH Demolition	Throughout field activities; refer to Project Schedule
MEC/MPPEH Demolition – Follow-up Phase	UXOSO/UXOQCS, MMG-TLI JV	When demolition occurs	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MEC/MPPEH Demolition	Throughout field activities; refer to Project Schedule
MDAS Disposal – Preparatory Phase	UXOSO/UXOQCS, MMG-TLI JV	Once prior to MDAS disposal/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MDAS Disposal	Throughout field activities; refer to Project Schedule

Table 31-2: Assessments – Three Phases of Control and Operational Control

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
MDAS Disposal – Initial Phase	UXOSO/UXOQCS, MMG-TLI JV	Once at the beginning of MDAS disposal/when there is a change in personnel or change in assignment	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MDAS Disposal	Throughout field activities; refer to Project Schedule
MDAS Disposal – Follow-Up Phase	UXOSO/UXOQCS, MMG-TLI JV	When delivered	Throughout field activities; refer to Project Schedule	Quality Control 3-Phase Inspection Checklist and DQCR – MDAS Disposal	Throughout field activities; refer to Project Schedule
MC Sampling – All Phases	UXOSO/UXOQCS, MMG-TLI JV	Once per day during sample collection	Throughout field activities; refer to Project Schedule	Field documentation	At conclusion of sample collection activities
MC Sampling – Field Audit	UXOSO/UXOQCS, MMG-TLI JV	Once per day during sample collection activities	Throughout field activities; refer to Project Schedule	Field documentation/audit checklists	At conclusion of sample collection activities

Table 31-3: Assessment – Response and Corrective Action

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing CA	Responsible for monitoring CA implementation
Site Preparation – All Phases	SUXOS, MMG-TLI JV	NCAR	Within two working days	SUXOS, MMG-TLI JV	UXOSO/UXOQCS, MMG-TLI JV
Instrument-assisted Surface Sweep Grid – All Phases	SUXOS, MMG-TLI JV	NCAR	Within two working days	SUXOS, MMG-TLI JV	UXOSO/UXOQCS, MMG-TLI JV
DGM Grid – All Phases	Project Geophysicist, AECOM	NCAR	Within two working days	Site/Field Geophysicist, AECOM	QC or Project Geophysicist, AECOM
DGM Data Deliverable Assessment	Project Geophysicist, AECOM	Internal e-mail and/or NCAR	Within two working days	Project Geophysicist, AECOM	Project Geophysicist, AECOM
Database Management	SUXOS, MMG-TLI JV; Off-Site Database Manager, AECOM	NCAR	Within two working days	SUXOS, MMG-TLI JV; Off-Site Database Manager, AECOM	UXOSO/UXOQCS, MMG-TLI JV; QC Geophysicist, AECOM
Intrusive Results Assessment	QC or Project Geophysicist, AECOM	Internal e-mail and/or NCAR	Within two working days	SUXOS, MMG-TLI JV	QC or Project Geophysicist, AECOM
DGM Grids – All Phases	SUXOS, MMG-TLI JV	NCAR	Within two working days	SUXOS, MMG-TLI JV	UXOSO/UXOQCS, MMG-TLI JV
MEC/MPPEH Demolition – All Phases	SUXOS, MMG-TLI JV	NCAR	Within two working days	SUXOS, MMG-TLI JV	UXOSO/UXOQCS, MMG-TLI JV
MDAS Disposal – All Phases	SUXOS, MMG-TLI JV	NCAR	Within two working days	SUXOS, MMG-TLI JV	UXOSO/UXOQCS, MMG-TLI JV
MC Sampling – All Phases	Project Geologist, MMG-TLI JV	NCAR	Within two working days	MC Sampling TL, MMG-TLI JV	PM, MMG-TLI JV
MC Sampling – Field Audit	Project Geologist – MMG-TLI JV	NCAR	Within two working days	MC Sampling TL, MMG-TLI JV	PM, MMG-TLI JV

31.0 Inspections

QC inspections may be performed periodically to ensure systems are functioning as planned. By or under direction of the CQCS, management surveillance of the QC program ensures that operations are performed IAW approved plans. The inspections include a review of procedures, logs, records, etc. Management reviews help determine discrepancies in information collected or if conditions and practices create the potential for QC problems so that corrections can be implemented before problems occur.

Listed below are QC processes and procedures associated with personnel, data collection/analysis, instruments/sensors and other equipment, data deliverables, and for measuring the effectiveness of the DFWs. QC processes provide for:

- Testing and calibrating equipment used to perform work, including the following:
    - Each geophysical component will be noted according to make, model, and serial number in the field logbooks and/or in the digital data logger for the respective instruments.
    - Functional instrument tests for the system will be digitally recorded and available for review by QC/QA personnel.
    - All instruments and equipment that require calibration will be checked prior to the start of each workday.
    - Batteries will be replaced as needed, and the instruments will be checked against a known source.
    - Instrument-specific functional testing procedures will be performed IAW methods described in the GSV.
- QC procedures will be implemented to ensure data collection, data processing, and interpretation methods are monitored at a sufficient level to meet the overall program objectives.
- Monitoring/measuring the effectiveness of work performed, including the following:
    - The UXOSO/UXOQCS and his staff are responsible for ensuring that personnel accomplish all QC checks and that the appropriate log entries are made. He/she performs random, unscheduled checks to ensure that personnel accomplish all work specified in the UFP-QAPP and submits a report of their findings to the SUXOS.
    - Project deliverables, such as the UFP-QAPP and RACR, will be prepared by the PM and reviewed by the CQCS prior to submittal to USACE. Documentation of internal reviews will be maintained in the project file.
    - QC documentation will include descriptions of the areas checked and the results of the QC checks and will be maintained as part of the project file.
    - NCARs will be submitted to the CQCS, PM and technical lead for the functional area reviewed and will be maintained as part of the project file.

Each DFW will be monitored and documented, either in a bound field logbook, on prescribed forms, or digitally in a tablet. NCARs will be issued when an activity is not performed IAW the UFP-QAPP or when results are not within a specified tolerance. In these situations, the PM and operations personnel will conduct a RCA and develop a CA for approval and implementation. Acceptable tolerances may be adjusted based on the outcome of the RCA process and unexpected field conditions. These “adjustments” will be submitted to the USACE for concurrence and documented as necessary on a Field Change Request form.

31.1 Non-Conformance Criteria for Quality Inspections

Any non-conformance to the work or contractual requirements will be documented. Non-conformance may include but is not limited to:

- Delivery of items or services that do not meet the contractual requirements of MMG-TLI JV or its subcontractors.
- Errors made in following work instructions or improper work instructions.
- Unforeseeable or unplanned circumstances that result in items or services that do not meet quality, contractual, and/or technical requirements.
- Technical modifications to the project by individuals without the requisite responsibility and authority. Non-conformance will be deemed to have occurred if services or delivery of items have not passed MMG-TLI JV QC pass/fail metrics and a RCA and CA assessment have not been performed.

31.2 Corrective Action for Quality Inspections

Guidelines have been established to assure conditions adverse to quality such as malfunctions, deficiencies, deviations, and errors are promptly investigated, documented, evaluated, and corrected. When an activity is identified to be in non-conformance (i.e., not being performed to required specifications, not within specified tolerance, not adhering to a specific scope of work, or in violation of the APP/SSHP), it will be recorded on an NCAR. Each nonconforming activity must have a probable cause identified. This analysis will identify the problem and impact on achieving performance goals/expectations, analyze the causes of the problem, and evaluate solutions to prevent the issue/event from reoccurring. Condition identification, cause, reference documents, and CA planned will be documented on the NCAR and reported to the UXOSO/UXOQCS, the PM, and the CQCS. Implementation of CAs will be verified by documented follow-up action. All project personnel have the continuing responsibility to identify problem areas promptly, solicit approved CAs, and report any condition adverse to quality. In general, corrective/preventive actions will be initiated at a minimum:

- When predetermined acceptance standards are not attained.
- When procedures or data compiled are determined to be faulty.
- When equipment or instrumentation is found to be faulty.
- As a result of system and performance inspections.
- As a result of management assessment.

31.3 Documentation

Preparation, review, approval, and issuance of documents affecting quality will be controlled to the extent necessary to ensure compliance to specified requirements. Project documents that will be controlled, if issued, include the following:

- Meeting minutes and conference notes
- Project Database (downloaded from tablets)
- DQCRs and weekly reports
- SUXOS Daily Report
- NCARs and NCAR log
- FCRs and FCR Log
- Seed Tracking Logs

- Field Data Sheets
- Boring Logs/Well Installation forms
- Material inspection and shipping logs
- NCARs
- Rework Items list
- Photograph log
- Field logbooks

The use of the DQCRs, NCAR, and FCR is further described in the sub-paragraphs below.

31.3.2 Daily Quality Control Report

The UXOSO/UXOQCS is responsible for maintenance of current records of QC operations, activities, inspections, and tests performed, including the work of subcontractors and suppliers. The DQCR is used to document all site operations IAW recognized performance criteria; to inspect a particular procedure or deliverable and quality of work efforts; and document the follow-up three-phase control process. The records will include factual evidence that required QC activities and tests were performed. The DQCR will be completed to document site activities covered by the UFP-QAPP and will include:

- Records of inspection and/or testing performed.
- Identification and location of each DFW and its current phase (preparatory, initial, follow-up) of completion.
- Results of inspections and/or testing.
- Location and description of deficiencies.
- Deficiencies corrected as of the date of the report.
- Rework items.
- Deviations from plans, difficulties, and resolution.
- Test and/or control activities performed with results and references to specifications and/or plan requirements, including the control phase (preparatory, initial, and follow-up) and deficiencies.

The records will describe both conforming and nonconforming features and include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The DQCRs will be maintained on-site and furnished to USACE, USAEC and BRAC upon request by 10:00 a.m. on the first workday following the date covered by the report or as agreed to by the USACE. The report need not be submitted for days in which no work is performed. At a minimum, one report will be prepared and submitted for every seven days of no work and on the last day of a no-work period. All calendar days will be accounted for throughout the life of the contract. The first report following a day of no work will summarize work for that day only.

The DQCR will be signed and dated by the UXOSO/UXOQCS. The report will include copies of test reports or as agreed to by the client.

31.3.3 SUXOS Daily Report

The Contractor Production Report will be prepared for each workday. The Contractor Production Report will be prepared, signed, and dated by the SUXOS and checked by the UXOSO/UXOQCS and will contain:

- Contractor and subcontractor(s) and their area of responsibility.
- Trades working on the project that day and number of personnel.
- Operating equipment, with hours worked, idle, or down for repair.
- Work performed that day, including location, description, weather conditions, and who did the work.
- Any delays encountered.
- Site visitors and the purpose of the visit.
- Job safety evaluations stating what was checked, results, and instructions or CAs.
- A list of instructions given and/or received from the client and conflicts in plans and/or specifications.
- Contractor’s verification statement.

31.3.4 Non-Conformance and Corrective Action Report

An NCAR is instituted as a result of delivery of items or services by MMG-TLI JV that do not meet the contractual requirements; errors made in following work instructions; process failure; unforeseeable or unplanned circumstances that result in items or services that do not meet quality, contractual, or technical requirements; technical modifications to the project’s processes or procedures by an individual(s) who do not have the responsibility and authority; and errors in craftsmanship and trade skills.

31.3.5 Field Change Report

An FCR is implemented for any unforeseen circumstances that result in modification to or to correct discrepancies or errors in the approved UFP-QAPP (and all appendices), including SOPs.

31.3.6 Field Logbooks

The UXOSO/UXOQCS will maintain a logbook to document QC activities. The information in the logbook is intended to serve as a phone log and memory aide in the preparation of the DQCR and in addressing follow-up questions that may arise. Logbooks (electronic or paper) will be maintained by the SUXOS and all site management positions (e.g., Project Geologist [or Project Geologist’s on-site representative)], TLs).

31.3.7 Photographs and Photo Logs

In addition to photos collected by field teams via personal data collection devices and incorporated into the Project Database, the SUXOS will maintain photographs and a photo log to document site activities. Each photograph will have a date and time stamp on it, or the photograph will show a sign board documenting the date and time clearly and legibly in the photograph. The photo log will identify each photograph by date, time, location, and activity. Prior to the release of any photos, the photos will be reviewed to ensure compliance with safety procedures and practices and submitted to USACE, USAEC and BRAC for review and approval.

31.3.8 Conference Notes and Confirmation Notes

In addition to other required documentation, the PM or designee is responsible for taking notes and preparing the reports of all conferences. Conference notes will be typed, and the original report furnished to the USACE within five working days of the date of the conference for concurrence and subsequent distribution to all attendees. At a minimum, this report will include:

- Date and place the conference was held.
- List of attendees, including name, organization, and telephone number.
- Comments made during the conference and decisions affecting criteria changes.
- Conference notes that augment the written comments.
- Action items as a result of the call and who is responsible for the action item resolution.

The PM is also responsible for providing a record of all discussions, verbal directions, telephone conversations, and so forth in which MMG-TLI JV personnel or their representatives participate on matters relating to the contract and work.

UFP-QAPP Worksheet #34: Data Verification, Validation, and Usability Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

Requirements/Specifications:

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Planning Documents/Records				
1	Approved UFP-QAPP (and all appendices)	X		X
2	Contract specifications	X	X	X
3	Approved ESS	X	X	
4	Approved PMP	X	X	
5	Blind QC Seed Plan	X	X	X
Field Records				
6	Field logbooks	X		
7	Record of Training	X		
8	Equipment calibration records	X	X	
9	Equipment-specific checklists and inspection records	X	X	
10	ITS Score Sheets	X	X	
11	Seed Tracking Log	X	X	
12	Recovered object verification checklist	X	X	
13	Photographs	X		
14	DQCRs and weekly reports	X	X	X
15	SUXOS Daily Report	X	X	X
16	Chain-of-custody forms	X	X	X
17	FCRs and FCR log	X	X	
18	NCARs and NCAR log	X	X	X
19	MEC Accountability Log	X	X	
20	Explosive Accountability records	X	X	
21	MDAS Certificate of Destruction	X	X	
22	DD Forms 1348-1A	X		X

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Electronic Data				
23	Raw data files	X	X	
24	Processed data files	X	X	X
25	Data Processing log (detection survey)	X		
26	Target anomaly list (detection survey)	X	X	
27	Final data archive (detection survey)	X	X	
28	PLS Report	X	X	X
29	EDD from Laboratory in (SEDD_2a format)	X	X	X
30	Project Database	X	X	X
Analytical Data Package				
31	Cover sheet (laboratory identifying information)	X		
32	Case narrative	X	X	X
33	Internal laboratory chain-of-custody	X	X	
34	Sample receipt records	X	X	
35	Sample chronology (i.e., dates and times of receipt, preparation, & analysis)	X	X	
36	Communication records	X	X	
37	LOD/LOQ establishment and verification	X	X	X
38	Standards traceability	X	X	X
39	Instrument calibration records	X	X	X
40	Definition of laboratory qualifiers	X	X	X
41	Results reporting forms	X	X	X
42	QC sample results	X	X	X
43	Corrective action reports	X	X	X
44	Raw data	X	X	X
45	Electronic data deliverable	X	X	
Interim and Final Reports/Deliverables				
46	IVS Letter Report	X	X	X
47	Production Area Seed Report	X		X
48	RACR	X	X	X
49	GIS Deliverable	X	X	X

UFP-QAPP Worksheet #35: Data Verification Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Procedures that will be used to verify project data are presented below. Data verification is a completeness check to confirm that the required activities were conducted, the specified records are present, and the contents of the records are complete. Data validation is the evaluation of conformance to stated requirements.

Activity and Records Reviewed	Requirements / Specifications	Process Description/Frequency	Responsible Person(s)	Documentation
Site Preparation – Civil Survey	UFP-QAPP; MEC SOP 18-01	For subcontracted civil survey, the surveyors report is reviewed upon receipt for completeness and accuracy/Once	UXOSO/UXOQCS; Project or Site Geophysicist	Surveyor's Report; DQCR
Site Preparation – Instrument-Assisted Surface Sweep Grids	UFP-QAPP; MEC SOP 18-02	UXO teams document instrument-assisted surface sweep activities using tablets (or Field Data Sheets if tablets are not in use) and in the field logbook. The SUXOS documents daily activities in the SUXOS Daily Report. This documentation is reviewed for completeness and accuracy/Every day in which instrument-assisted surface sweep is performed; UXOSO/UXOQCS performs TPC inspections/Rate identified in Worksheets #31, #32, and #33	SUXOS; UXOSO/UXOQCS; Data Manager	DQCR; SUXOS Daily Report; equipment-specific calibration and/or inspection records; ITS Score Sheets; Project Database
QC Blind Seeding	UFP-QAPP; MEC SOP 18-01 and 18-04, GEO-4	QC blind seed details (i.e., ID, type, orientation, depth, and surveyed coordinates) are recorded in the Seed Tracking Log. The Seed Tracking Log is reviewed for completeness and accuracy/Daily during placement of seeds, during data processing, while monitoring subsurface removal/inspection results	UXOSO/UXOQCS; QC Geophysicist	Seed Tracking Log; Project Database; photographs

Activity and Records Reviewed	**Requirements / Specifications**	**Process Description/Frequency**	**Responsible Person(s)**	**Documentation**
Initial IVS Survey	UFP-QAPP; GEO-3	Verify the initial IVS survey has been conducted according to the UFP-QAPP and documented in the IVS Letter Report; all specifications have been achieved or exceptions noted; the IVS Letter Report has been approved by the USACE QA Geophysicist; signatures and dates are present; and that the initial IVS survey is documented and included as part of the Project Database/Once	Site Geophysicist; Project Geophysicist	IVS Letter Report Project Database
Geophysical Data Collection	UFP-QAPP; GEO-5	Daily QC checks are documented for each DGM team; DGM teams document the DGM grid in tablet; detailed field notes are recorded; raw data is submitted to AECOM's FTP site/Daily; Site Geophysicist performs and documents submittals/On all days DGM is collected	Project or Site Geophysicist; UXOSO/UXOQCS	Raw data files; Project Database (Access)
Geophysical Data Processing	UFP-QAPP; GEO-6	For each dataset: Quality requirements are documented in the Project Database. Processed data and target selections are posted for QC review/QC review and submittal to USACE QA occur on a dataset basis within one week of data collection	Data Processor; Project Geophysicist	Processed data files; Project Database
MEC/MPPEH Disposition – MEC/MDEH Demolition	UFP-QAPP; MEC SOP 18-04; MEC SOP 18-05	UXOSO/UXOQCS reconciles MEC Accountability and Explosive Accountability records with MEC recovered and donor explosives used/When demolition occurs;	SUXOS; UXOSO/UXOQCS	DQCR; MEC Accountability record; Explosive Accountability record; SUXOS Daily Report; Project Database

Activity and Records Reviewed	**Requirements / Specifications**	**Process Description/Frequency**	**Responsible Person(s)**	**Documentation**
		UXOSO/UXOQCS performs TPC inspections/Rate identified in Worksheets #31, #32, and #33		
MEC/MPPEH Disposition – MDAS Disposition	UFP-QAPP; MEC SOP 18-06	UXOSO/UXOQCS will review all certification/verification documentation/prior to removing from site; UXOSO/UXOQCS performs TPC inspections/Rate identified in Worksheets #31, #32, and #33	SUXOS; UXOSO/UXOQCS	DQCR; MDAS Certification/Verification; SUXOS Daily Report; Project Database
Validation of analytical data	UFP-QAPP; most current National Functional Guidelines; DoD QSM 5.3	Data validation must be completed on all analytical data/Once when EDD is delivered	Program Chemist	Data Validation Report, SEDD_2a EDD

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UFP-QAPP Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

This worksheet documents procedures that will be used to validate the overall anomaly detection, interpretation, and removal approach as it is implemented at the site. The purpose of process validation is to provide added confidence in the ability of the sample design to 1) detect and select anomalies meeting the project-specific detection threshold, and 2) remove (i.e., dig) and inspect those anomalies selected as targets. DQCRs will be used to continuously monitor field activities and document that processes are being performed in compliance with SOPs.

Geophysics Validation Approach

The validation approach involves testing the detection and selection of target anomalies in four ways:

- Demonstrating and documenting the detection limits of the geophysical sensors and accuracy of positioning systems in the IVS Letter Report and demonstrating and documenting the analog equipment function and analog equipment operator capabilities via equipment calibration records and ITS Score Sheets.
- Providing continuous verification that the geophysical/positioning system is functioning IAW the metrics defined in the UFP-QAPP and the approved IVS Letter Report via DGM data processing reports.
- Placing “blind” verification seeds at the site prior to DGM to confirm that the seeds can be detected and correctly selected as a target as documented in the Seed Tracking Log.
- Documenting and verifying MPC and MQO metrics are achieved for raw data files, processed data files, and data in the Project Database.

Documentation supporting these verification/validation steps will be provided to the USACE QA POC IAW the requested schedule. Any verification/validation failures (i.e., failure to detect and correctly select seeds or failure to correctly select an actual target of interest [TOI] as a target) will require an RCA and appropriate CA as documented in an NCAR.

Munitions and Explosives of Concern Detection and Removal Validation Approach

The verification activities related to data documenting the removal and disposition of targets detected during the subsurface removal/inspection are detailed throughout the UFP-QAPP. The blind seeds described in the UFP-QAPP will provide additional verification of the removal process as they will be tracked from placement through the removal phase in the Seed Tracking Log. Documentation of the identification of blind seeds in the dataset (i.e., in the dig list) and documentation of the recovery of blind seeds will be provided in the Project Database, QC Geophysicist reports, and DQCRs. The USACE may provide additional independent validation of the removal activities IAW the QASP.

Munitions Constituents Data Validation Approach

A Stage 2a electronic data validation will be performed on all analytical data generated by the subcontracted laboratory utilizing ADR.NET or an equivalent system on 100% of the analytical data as outlined in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). The Program Chemist or designee will supplement the Stage 2a electronic data validation with a Stage 2b manual validation on 100% of the analytical data based upon this UFP-QAPP, the most current national functional guidelines, as well as the DoD QSM 5.3.

UFP-QAPP Worksheet #37: Data Usability Assessment
(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

This worksheet documents procedures that will be used to perform the DUA. The DUA will be performed as part of the RACR using the outputs from data verification and data validation. It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process and, like the systematic planning process, involves participation by key members of the PDT. The DUA evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, DQOs have been met, and the results can be used as intended with the acceptable level of confidence.

Personnel responsible for participating in the DUA preparation or review:

Name	Title	Organization	Role in Usability Assessment
Kyra Donnell	PM	MMG-TLI JV	Preparation
Brian Gentry	MEC Technical Lead	MMG-TLI JV	Preparation
Eric Middleditch	Program Chemist	MMG-TLI JV	Preparation
James “Clint” Morris	SUXOS	MMG-TLI JV	Preparation
Robert “Junior” Miller	UXOSO/UXOQCS	MMG-TLI JV	Preparation
Nikki Thomsen	CQCS	MMG-TLI JV	Reviewer
Harry Wagner	QC Geophysicist	AECOM	Reviewer
Garrick Marcoux	Program Geophysicist	AECOM	Preparation/Reviewer
Sara McNamara	Project Geophysicist	AECOM	Preparation
Zachary Beck	Bhate HTRW Technical Lead	Bhate	Preparation/Reviewer
Marcia Olive	Project Chemist	Bhate	Reviewer
Aaron Williams	USACE TM	USACE	Reviewer
TBD*	USACE Chemist	USACE	Reviewer
Mike Slavens	USACE OESS	USACE	Reviewer
Eric Kirwan	USACE QA Geophysicist	USACE	Reviewer

Documents used as input to the data usability assessment include the following:

- Approved UFP-QAPP
- Contract specifications
- All documents identified with an (*) in Worksheet #29
- RACR

- GIS Deliverable
- Laboratory report and chain-of-custody forms
- EDD
- Data verification/validation report

Data usability will be discussed in the RACR. The steps included in performing an assessment of the data usability will include the following:

Step 1	**Review the project's objectives and sampling design** *Review the DQOs. Are underlying assumptions valid? Were the project boundaries appropriate? Review the sampling design as implemented for consistency with stated objectives. Were sources of uncertainty accounted for and appropriately managed? Summarize any deviations from the planned sample design and describe their impacts on the data quality objectives.*
Step 2	**Review the data verification and data validation outputs and evaluate conformance to MPCs identified on Worksheet #12 and acceptance criteria identified in Worksheets #22 and #28** *Review the site-specific project documents/data for completeness. Review available QC and QA reports, including NCARs and the data validation report. Evaluate the implications of unacceptable QC results. Summarize the impacts of non-conformances on data usability. Were all data inputs satisfied? Identify data gaps.*
Step 3	**Document data usability, update the CSM, and draw conclusions** *Determine if the data can be used as intended, considering implications of deviations and CAs. Assess the performance of the sampling design and identify any limitations on data use. Document whether DQOs were met. Considering the implications of any deviations and data gaps, can the data be used as intended? Are the data sufficient to answer the study questions? Update the CSM, apply the decision rules, and document conclusions.*
Step 4	**Document lessons learned and make recommendations** *Summarize lessons learned and make recommendations for changes to DQOs or the sampling design for the next phase of investigation/response or future similar studies. Prepare the data usability summary report.*

For analytical data, the following items will be assessed and conclusions drawn based on the results.

Precision: Precision is evaluated using the RPD. FD samples, LCS/laboratory control sample duplicate (LCSD) sample precision, as well as MS/MSD sample precision will be evaluated during data validation as stated in Worksheet #12 and Worksheet #28. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be documented.

Accuracy/Bias Contamination: Accuracy is evaluated by calculating the %R. Results for all laboratory MBs will be evaluated during data validation. Laboratory data will be qualified based on the criteria listed in Worksheet #12 and Worksheet #28. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn, and any limitations on the use of the data will be documented.

Overall Accuracy/Bias: Results for all LCS, surrogate, and MS/MSD recoveries that are outside evaluation criteria will be evaluated during data validation. The results will be checked versus those listed in Worksheet #12 and Worksheet #28. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be documented.

Sensitivity: Results for the sensitivity check standard will be provided by the laboratory for all analyses. The results for each analyte will be checked against the performance criteria presented on Worksheet #12 and cross-checked against the laboratory-specific LOQ presented on Worksheets #15a and #15b. Results for analytes that exceed criteria will be documented. Any conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be documented.

Representativeness: A measure of representativeness will be provided by assessing if the proper analytical procedures, appropriate methods, laboratory SOPs, holding times, and collection procedures were followed. Any conclusions about the representativeness of the analyses will be drawn, and any limitations on the use of the data will be documented.

Comparability: The results will be compared to the criteria on Worksheets #15a and #15b. Comparability is also achieved by using standard sampling and analysis procedures that can be reproduced.

Completeness: A completeness check will be performed on all data generated by the laboratory. Completeness criteria are presented on Worksheet #12 and Worksheet #28. Completeness will be calculated as the number of data points for each analyte that is deemed useable (not rejected) divided by the total number of data points for each analyte. Any conclusions about the completeness of the data will be drawn, and any limitations on the use of the data will be documented.

Graphics: Figures and tables will be prepared showing the analytical results for each sampling location.

Reconciliation: Each of the MPCs listed in Worksheet #12 and Worksheet #28 will be examined to determine if the objective was met. Each analysis will be evaluated separately in terms of the major impacts observed from the data review/validation and MPC assessments. Based on the results of these assessments, the quality of the data will be determined. Usability of the data will be based on the quality assessment. After establishing the usability of the data, it will be determined if the DQO was met and if comparison criteria (identified in Worksheet #15) were met. The final report will include a summary of all points that comprised the reconciliation of each objective. Any conclusions or limitations on the usability of any of the data will be documented.

* TBD will be identified in the Final UFP-QAPP.

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FIGURES

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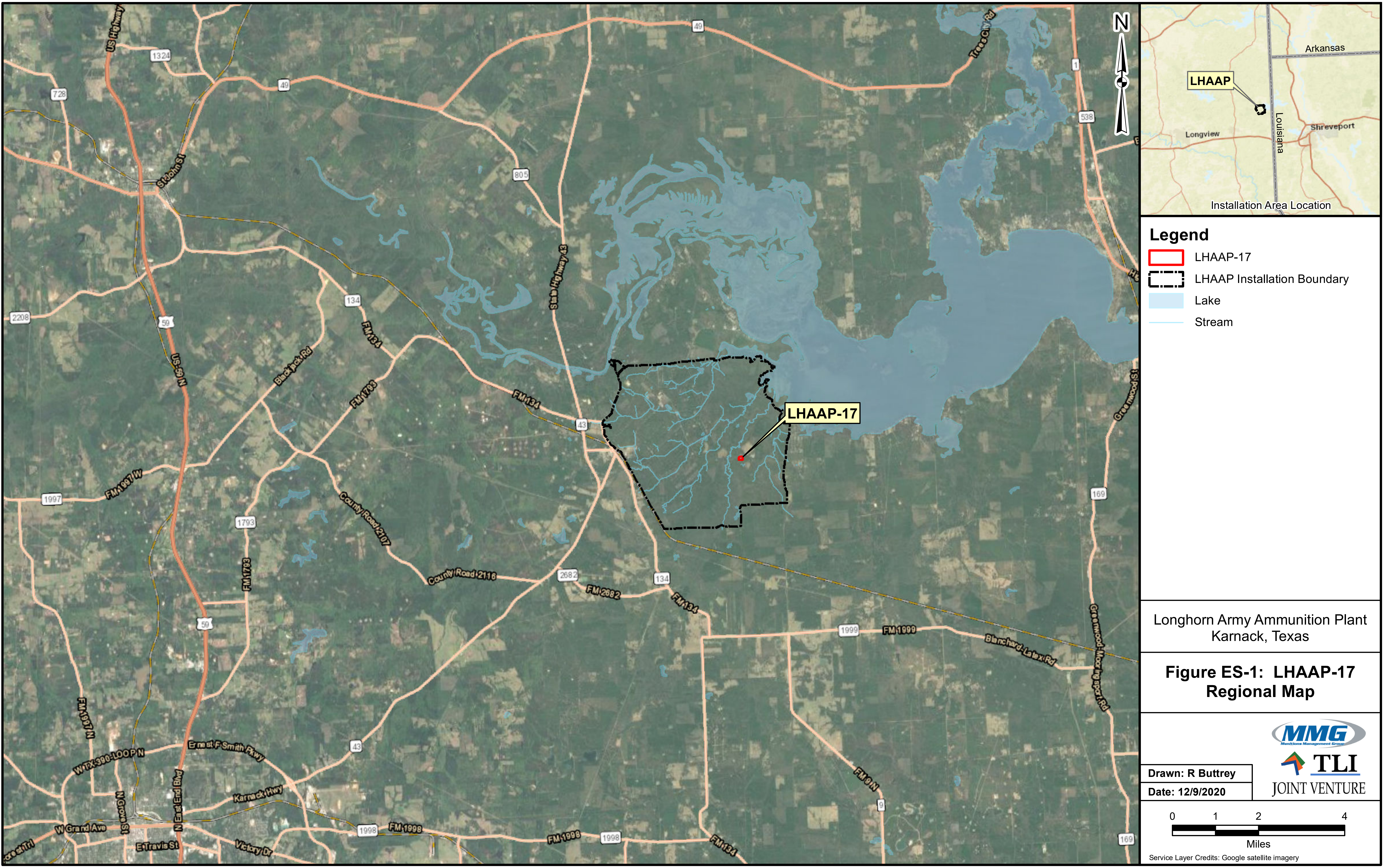

Legend

- 🟥 LHAAP-17
- ▭ LHAAP Installation Boundary
- 🟦 Lake
- — Stream

Longhorn Army Ammunition Plant
Karnack, Texas

Figure ES-1: LHAAP-17 Regional Map

Drawn: R Buttrey
Date: 12/9/2020

MMG Munitions Management Group
TLI
JOINT VENTURE

Service Layer Credits: Google satellite imagery

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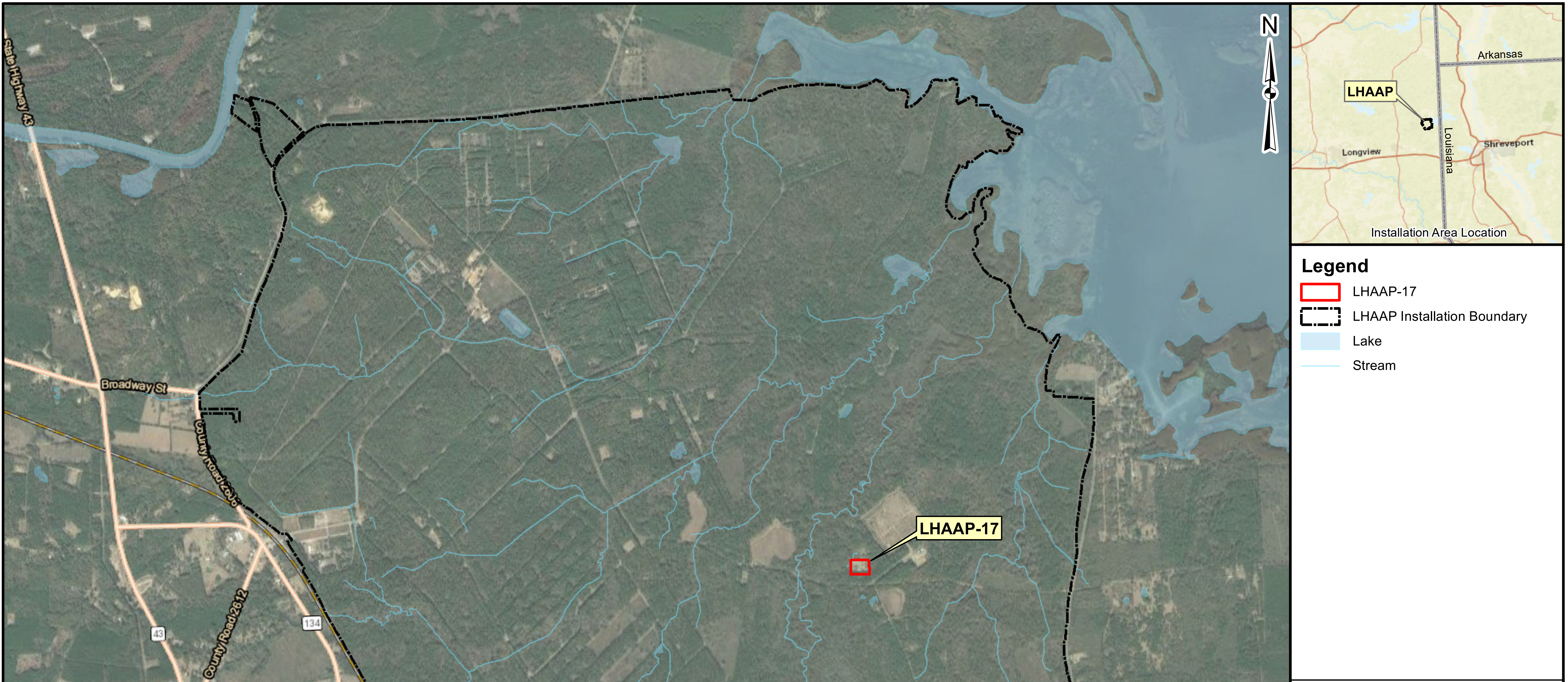

Longhorn Army Ammunition Plant
Karnack, Texas

Figure ES-2: LHAAP-17 Site Location Map

MMG
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Drawn: R Buttrey
Date: 12/9/2020

Service Layer Credits: Google satellite imagery

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Installation Area Location

Legend

▭ LHAAP-17
⬚ Currrent Excavation Limits
🟦 Backfilled
🟨 Currently Open
— Stream

Longhorn Army Ammunition Plant
Karnack, Texas

Remedial Design/Remedial Action
Work Plan Addendum

Figure ES-3: Site Boundary and Layout

MMG TLI Solutions JV

Drawn: R Buttrey
Date: 2/26/2021

0 25 50 100
Feet

Service Layer Credits: Google satellite imagery

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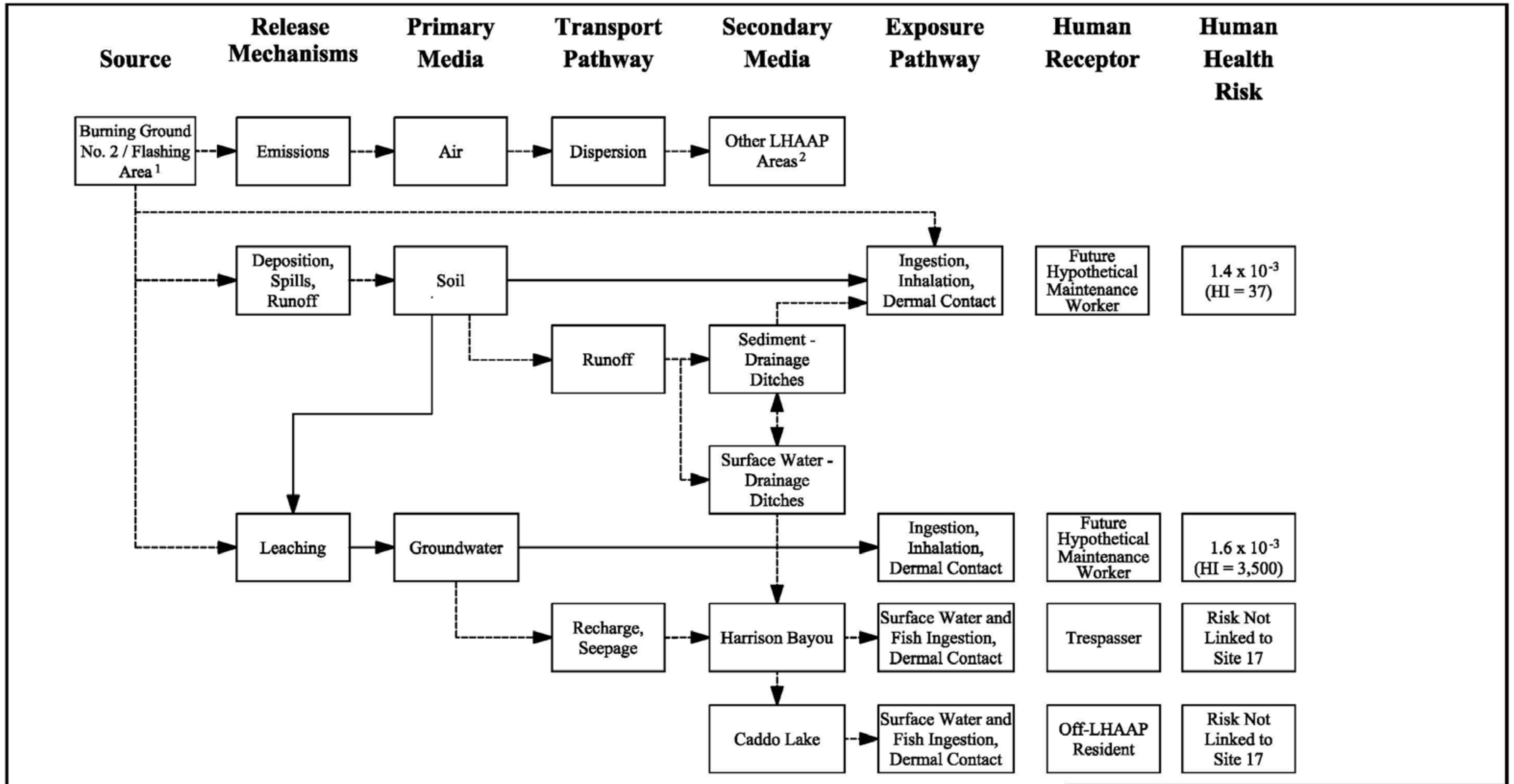

Pathway considered for remediation

Pathway *not* considered for remediation

Notes:

1. The waste residues were reportedly removed in 1984. Site characterization occurred after removal.

2. Contaminants (e.g., dioxins) dispersed via air emissions to other LHAAP sites are addressed in the CERCLA documentation for those sites. No gross contamination by dioxins has been encountered at Longhorn AAP.

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 10-1
HUMAN HEALTH CONCEPTUAL SITE MODEL
LHAAP-17, GROUP 2
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Source Document: Final Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunitions Plant, Karnack, Texas, August 2016.

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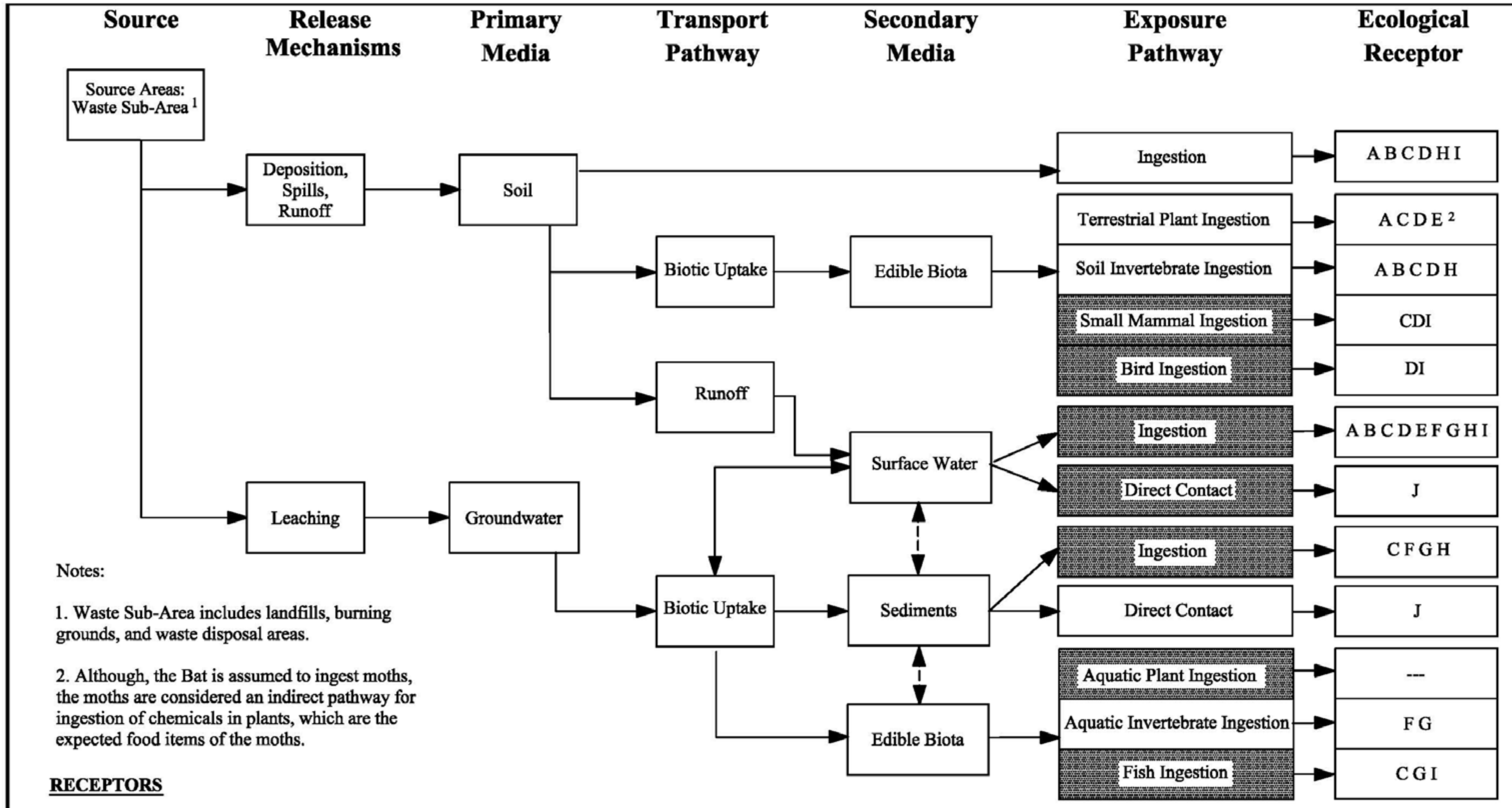

Notes:

1. Waste Sub-Area includes landfills, burning grounds, and waste disposal areas.

2. Although, the Bat is assumed to ingest moths, the moths are considered an indirect pathway for ingestion of chemicals in plants, which are the expected food items of the moths.

RECEPTORS

A. Deer Mouse
B. Short-Tailed Shrew
C. Racoon (& Racoon [Louisiana Black Bear])
D. Red Fox
E. Townsend's Big-Eared Bat
F. Bank Swallow
G. Belted Kingfisher
H. American Woodcock
I. Red-Tailed Hawk
J. Aquatic Life (benthic invertebrates)

--- = All receptors exposed to this pathway were determined not to be of concern.

Shaded cells indicate pathways that were not identified as significant, are background related, or were refined via site-specific investigations.

MMG TLI Solutions JV

U.S. Army Corps of Engineers
Tulsa District
Tulsa, Oklahoma

Figure 10-2
Ecological Conceptual Exposure Model
LHAAP-17, Group 2

Longhorn Army Ammunition Plant
Karnack, Texas

Source Document: “Final Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunitions Plant, Karnack, Texas, August 2016.”

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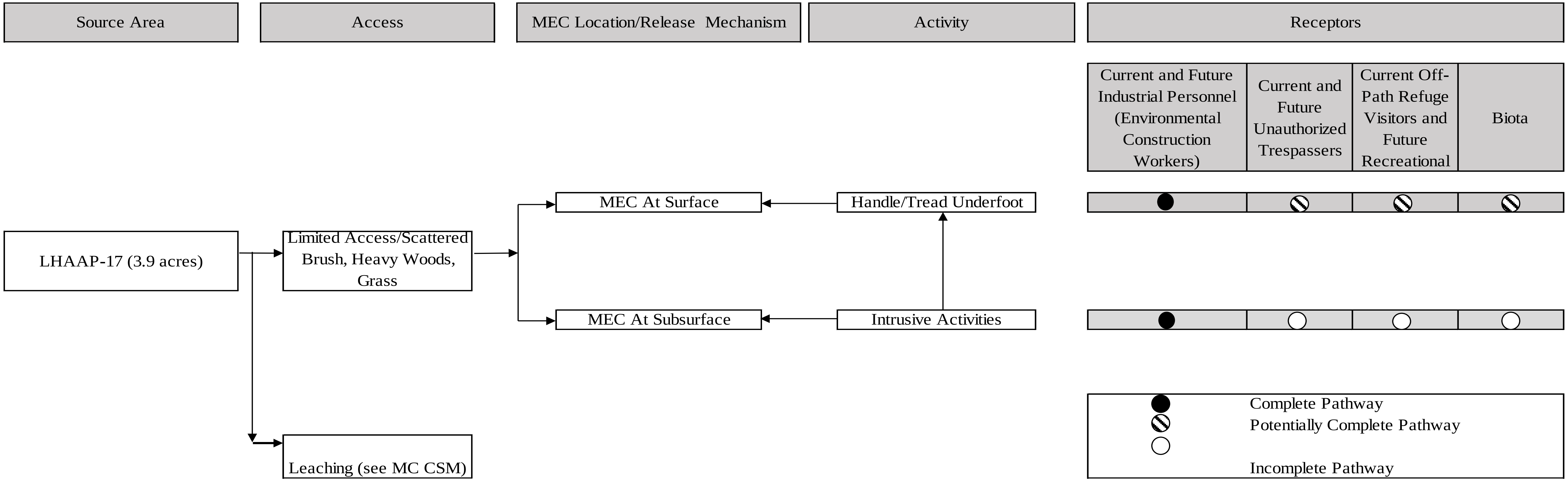
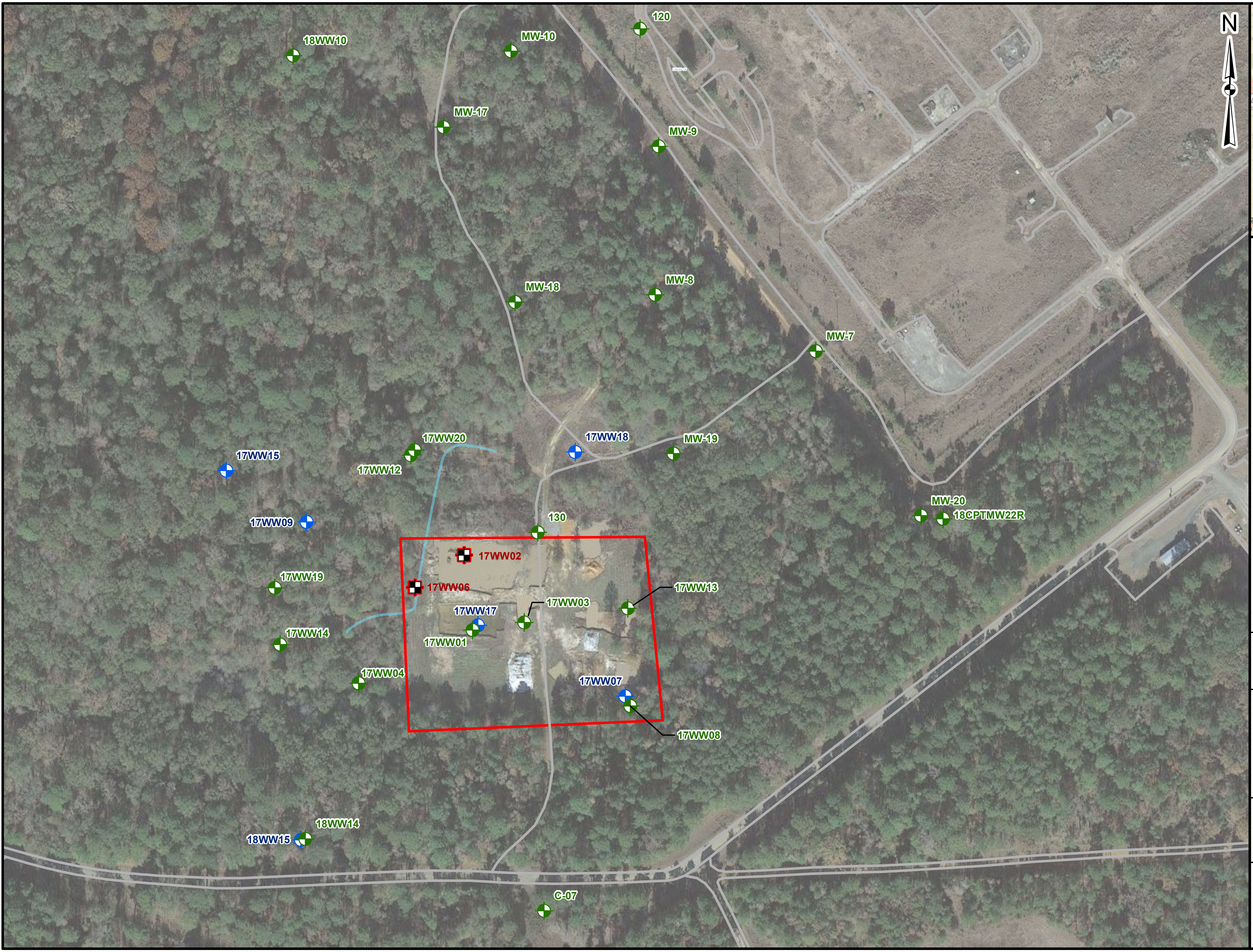
Figure 10-3. MEC Conceptual Site Model - LHAAP-17



Current and Future Industrial Personnel (Environmental Construction Workers)	Current and Future Unauthorized Trespassers	Current Off-Path Refuge Visitors and Future Recreational	Biota
●	▨	▨	▨
●	○	○	○

● Complete Pathway
▨ Potentially Complete Pathway
○ Incomplete Pathway



Installation Area Location

Legend

- ⊕ Proposed Extraction Well
- ⊕ Shallow Monitoring Well
- ⊕ Intermediate Monitoring Well
- 🟥 LHAAP-17 Boundary
- — Road
- — Stream

Note:

17WW02 and 17WW06 are the planned extraction wells, but 17WW01 may be added as an extraction well based on the results of the baseline sampling discussed in Section 5.5 of the Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No.2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas (Bhate Environmental Associates, Inc. [Bhate] 2019).

Longhorn Army Ammunition Plant
Karnack, Texas

Figure 10-4
LHAAP-17 Monitoring Well and Proposed Extraction Well Locations

0 90 180 360
Feet

1 inch = 180 feet

Prepared By:

MMG Munitions Management Group
TLI
JOINT VENTURE

Map Date: 7/29/2021

Service Layer Credits:
Google satellite imagery

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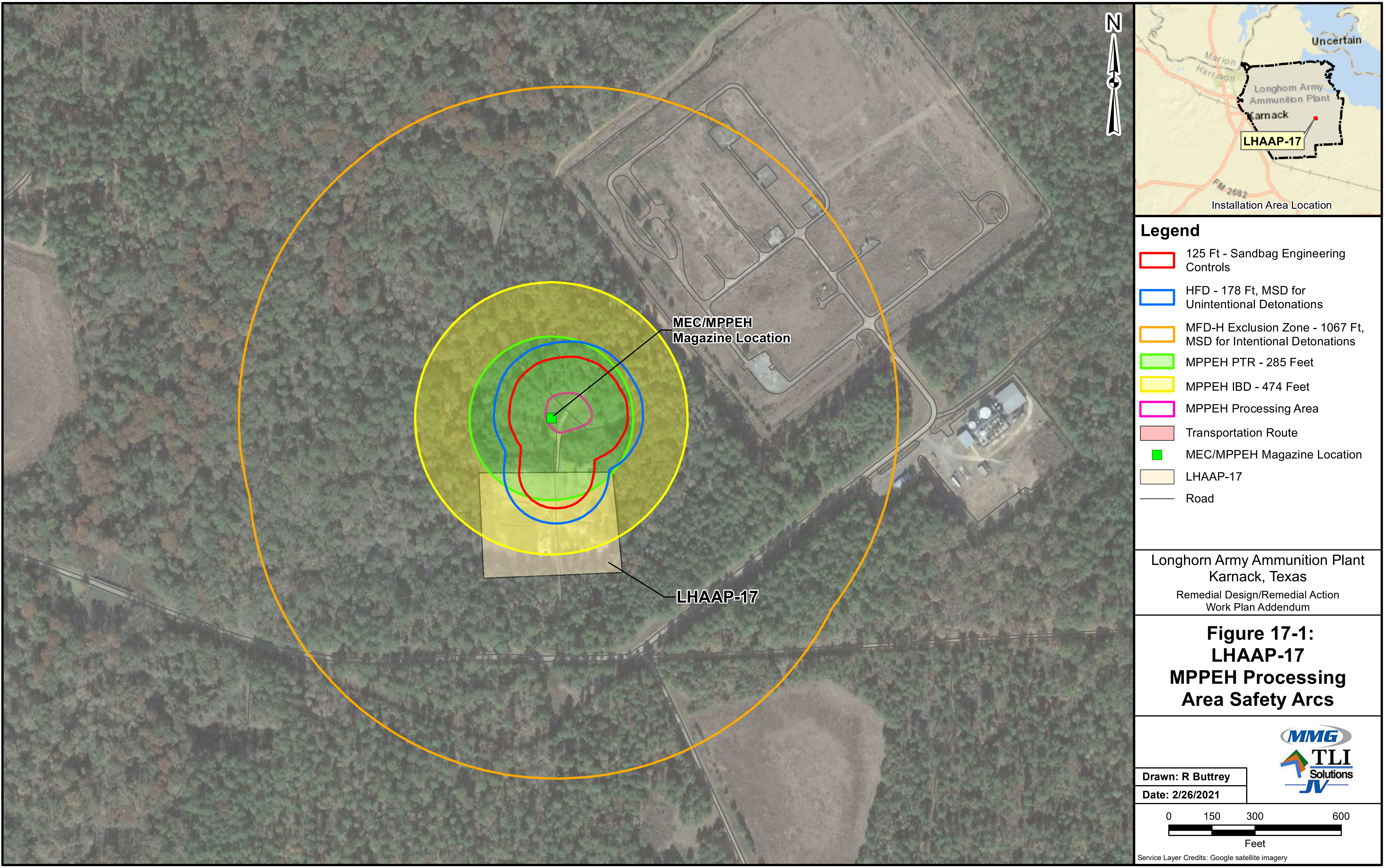

Longhorn Army Ammunition Plant
Karnack, Texas

Remedial Design/Remedial Action
Work Plan Addendum

**Figure 17-1:
LHAAP-17
MPPEH Processing
Area Safety Arcs**

MMG TLI Solutions JV

Drawn: R Buttrey
Date: 2/26/2021

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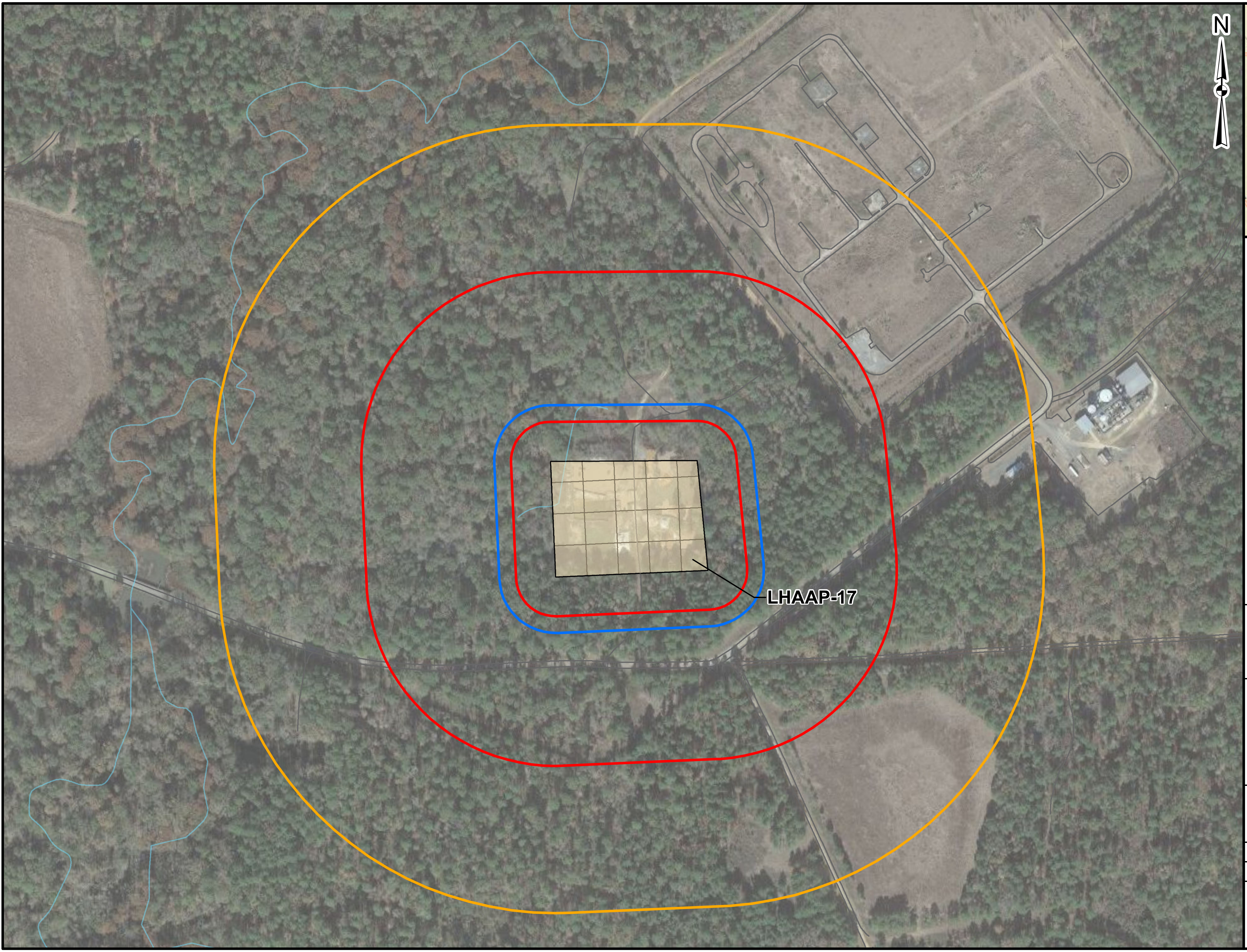

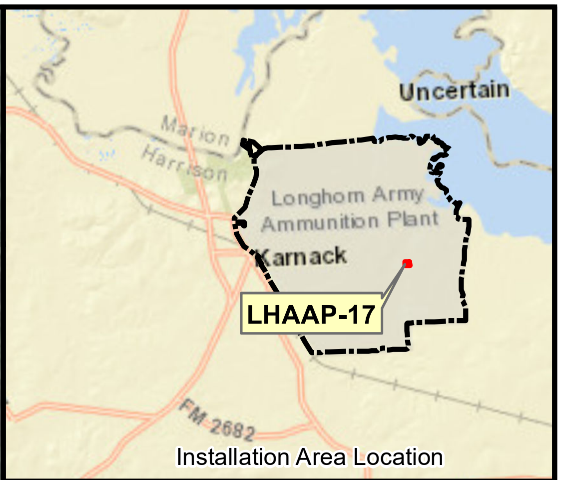

Installation Area Location

Legend

- 🟥 125 Ft - Sandbag Engineering Controls
- 🟦 HFD - 178 Ft, MSD for unintentional detonations
- 🟧 MFD-H Exclusion Zone - 1067 Ft, MSD for intentional detonations
- 🟫 LHAAP-17
- ☐ Investigation Grid Layout
- — Stream
- — Road

Longhorn Army Ammunition Plant
Karnack, Texas

Remedial Design/Remedial Action
Work Plan Addendum

Figure 17-2:
LHAAP-17
QD Safety Arcs Map

MMG TLI Solutions JV

Drawn: R Buttrey
Date: 2/26/2021

0 150 300 600
Feet

Service Layer Credits: Google satellite imagery

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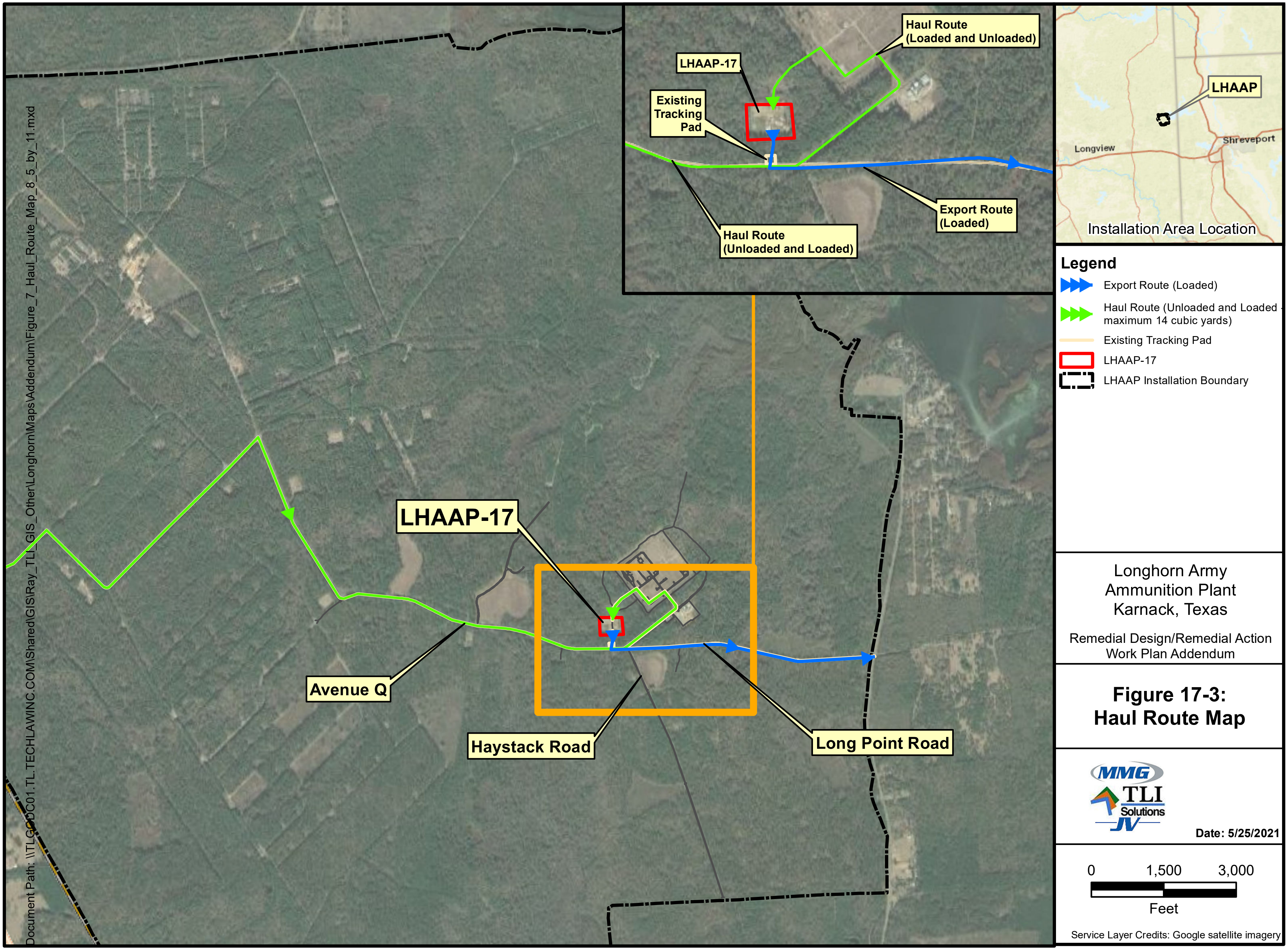

Legend

- ▶▶▶ Export Route (Loaded)
- ▶▶▶ Haul Route (Unloaded and Loaded maximum 14 cubic yards)
- — Existing Tracking Pad
- ▭ LHAAP-17
- ▭ LHAAP Installation Boundary

Longhorn Army
Ammunition Plant
Karnack, Texas

Remedial Design/Remedial Action
Work Plan Addendum

Figure 17-3:
Haul Route Map

MMG TLI Solutions JV

Date: 5/25/2021

Service Layer Credits: Google satellite imagery

Longhorn Army Ammunition Plant
Karnack, Texas

Remedial Design/Remedial Action
Work Plan Addendum

Figure 17-4:
Existing Confirmation Samples and Projected Excavation Limits

0 25 50 100
Feet

Service Layer Credits: Google satellite imagery

MMG TLI Solutions JV

Document Path: S:\GIS\Ray_TLI_GIS_Other\Longhorn\Maps\Addendum\Figure_6_Existing Confirmation Samples and Projected Excavation Limits.mxd

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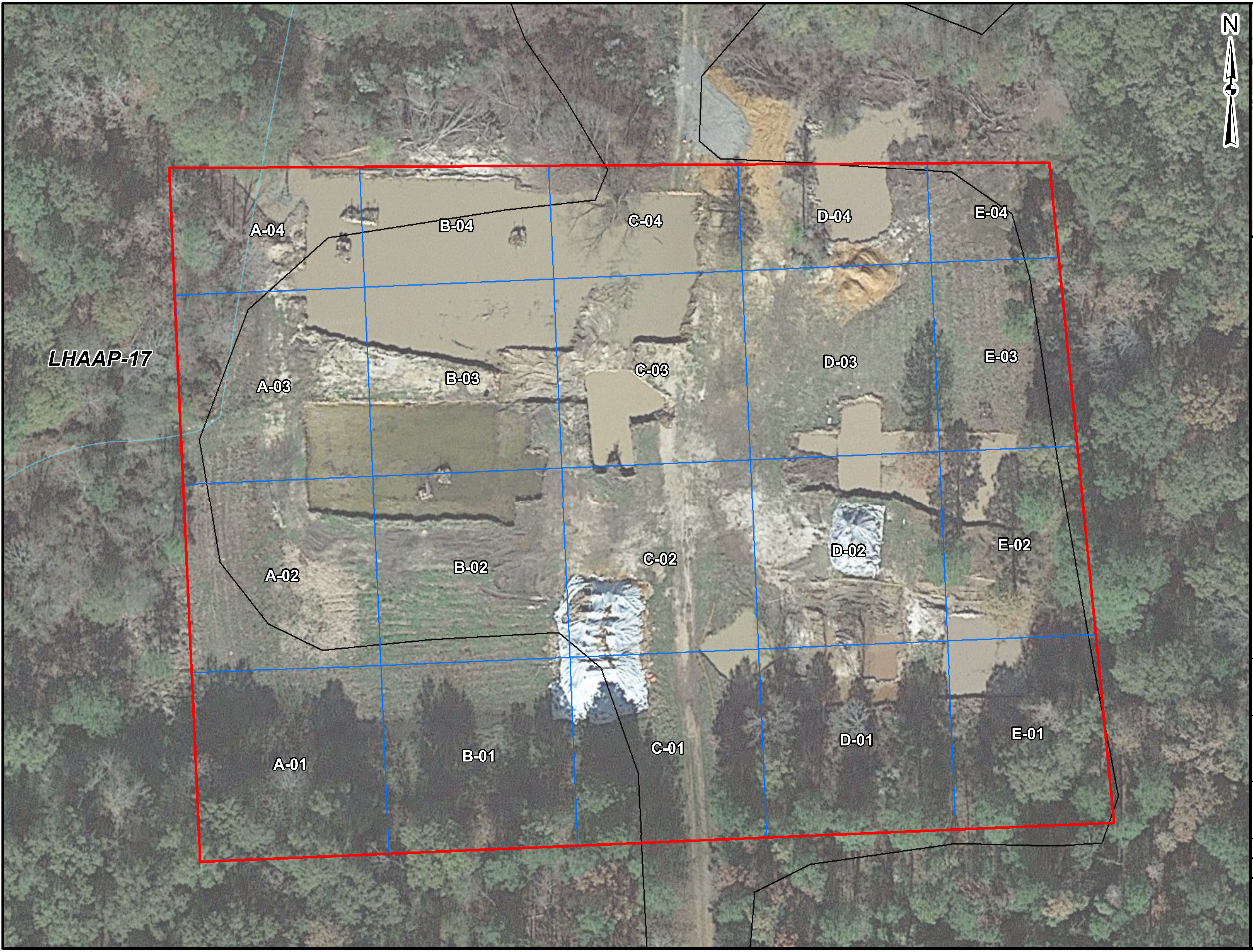


Installation Area Location

Legend

🟥	LHAAP-17
🟦	Investigation Grid Layout
—	Roads
—	Stream

Longhorn Army Ammunition Plant
Karnack, Texas

Figure 17-5: LHAAP-17 Investigation Grid Layout

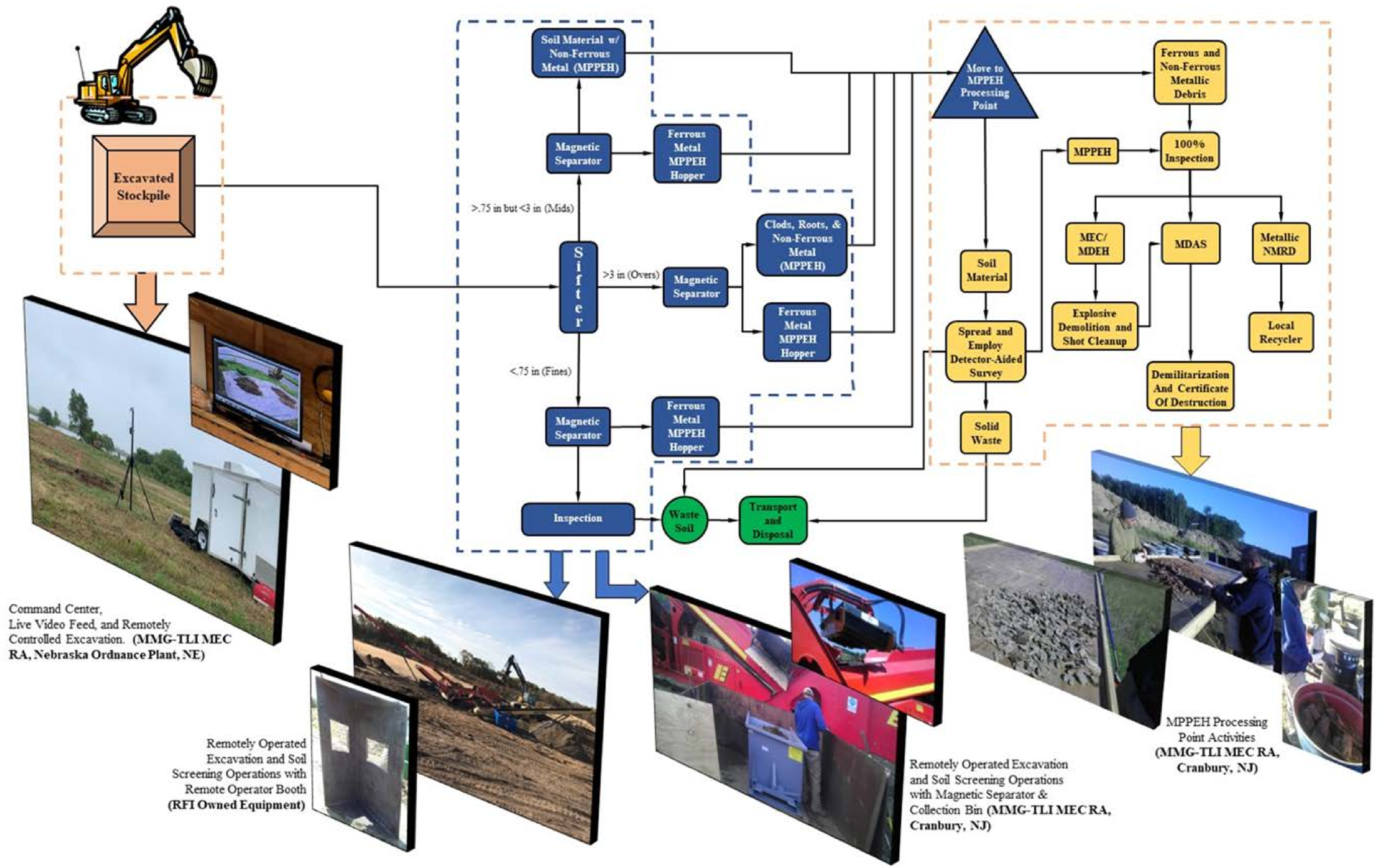
MMG
TLI
JOINT VENTURE

Drawn: R Buttrey
Date: 12/9/2020

0 25 50 100
Feet

Service Layer Credits: Google satellite imagery

Document Path: C:\Ray\TLI Solutions\Longhorn\Maps\QAPP\Figure_17-1_Investigation_Grid_Layout.mxd

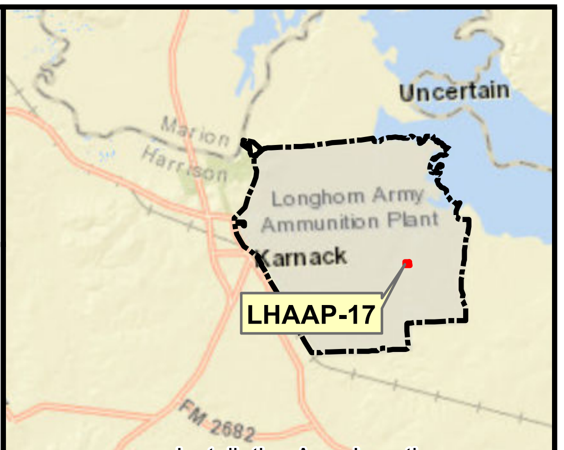


Command Center, Live Video Feed, and Remotely Controlled Excavation. **(MMG-TLI MEC RA, Nebraska Ordnance Plant, NE)**

Remotely Operated Excavation and Soil Screening Operations with Remote Operator Booth **(RFI Owned Equipment)**

Remotely Operated Excavation and Soil Screening Operations with Magnetic Separator & Collection Bin **(MMG-TLI MEC RA, Cranbury, NJ)**

MPPEH Processing Point Activities **(MMG-TLI MEC RA, Cranbury, NJ)**



Installation Area Location

Legend

🟩 **MPPEH Free**
🟨 **Non-Robotic Activities**
🟦 **Robotic Activities**

Longhorn Army Ammunition Plant
Karnack, Texas
Remedial Design/Remedial Action
Work Plan Addendum

Figure 17-6: Soil Screening Work Flow Process

Date: 2/8/2021

MMG
TLI
JOINT VENTURE

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APPENDIX A
ACCIDENT PREVENTION PLAN/ SITE SAFETY AND HEALTH PLAN

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ACCIDENT PREVENTION PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

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ACCIDENT PREVENTION PLAN

ENVIRONMENTAL SERVICES
MILITARY MUNITIONS RESPONSE PROGRAM, ENVIRONMENTAL REMEDIATION SERVICES AT LHAAP-17, KARNACK, TEXAS

Prepared for:

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Longhorn Army Ammunition Plant
Karnack, Texas

MATOC Contract No. W9128F18D0001

Task Order No. W912BV20F0207

August 2021

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ATTACHMENTS

List of Acronyms and Abbreviations

AED	Automatic External Defibrillator
AFB	Air Force Base
AHA	Activity Hazard Analysis
ALARA	as low as reasonable achievable
APP	Accident Prevention Plan
ASTM	American Society for Testing and Materials
BG	Burning Ground
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHP	Chemical Hygiene Plan
CIH	Certified Industrial Hygienist
COR	Contracting Officer’s Representative
CPR	cardiopulmonary resuscitation
CSMP	Cold Stress Monitoring Plan
CSP	Certified Safety Professional
CSPP	Construction Safety & Phasing Plan
D&D	Decontamination and Decommissioning
DGM	digital geophysical mapping
DNT	2,4-dinitrotoluene
DoD	United States Department of Defense
DOE	United States Department of Energy
DOT	United States Department of Transportation
EM	Engineering Manual
EMP	Explosives Management Plan
EMT	Emergency Medical Technician
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences

ES&H	Environmental, Safety, and Health
ESP	Explosives Site Plan
ESSP	Explosives Safety Site Plan
FEMA	Federal Emergency Management Agency
ft	foot
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HP	Health Physicist
HSMP	Heat Stress Monitoring Plan
HTRW	Hazardous, Toxic, and Radioactive Waste
IATA	International Air Transport Association
IAW	in accordance with
IH	industrial hygiene
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MEC	Munitions and Explosives of Concern
mm	millimeter
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC-TLI Solutions, Inc. Joint Venture
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MSDS	Material Safety Data Sheet
MTL	Munitions and Explosives of Concern Technical Lead
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
OESS	Ordnance and Explosives Safety Specialist

OPSEC	Operations Security
OSHA	Occupational Safety and Health Administration
PCD	Pueblo Chemical Depot
PM	Project Manager
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RADCON	Radiological Control
RCT	Radiological Controls Technician
RDW	remediation-derived waste
RI	Remedial Investigation
ROD	Record of Decision
SDS	Safety Data Sheet
SHM	Safety and Health Manager
SI	Site Investigation
SMS	Safety Management Specialist
SOP	Standard Operating Procedure
SP	Sweep Personnel
SPCC	Spill Prevention, Control, and Countermeasure
SPCD	Safety Plan Compliance Document
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SUXOS	Senior UXO Supervisor
SW	Support Worker
TechLaw	TechLaw Consultants, Inc
TLI	TLI Solutions, Inc.
TNT	2,4,6-trinitrotoluene
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan

USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOQP	Unexploded Ordnance Qualified Personnel
UXOSO	Unexploded Ordnance Safety Officer
UXOT	Unexploded Ordnance Technician
UXOT I	Unexploded Ordnance Technician I
UXOT II	Unexploded Ordnance Technician II
UXOT III	Unexploded Ordnance Technician III
VI	chromium

1.0 INTRODUCTION

1.1 Plan Preparation

This Accident Prevention Plan (APP) was developed specifically for Longhorn Army Ammunition Plant (LHAAP), Texas. The plan was prepared in accordance with (IAW) United States Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1 (2014). This plan is approved for field activities at LHAAP-17. Plan preparation, approval, and concurrence are documented below.

Owens P. Carter

_8/24/2021_____________

Plan Prepared by: Owens Carter,
Safety Management Specialist (SMS)
Safety Specialist
Munitions Management Group, LLC (MMG)-TLI Solutions, Inc. (TLI) Joint Venture (MMG-TLI JV)
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Date

_8/24/2021______________

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8/25/2021

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Certified Safety Professional (CSP)
Corporate Health and Safety Director
MMG-TLI JV
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2.0 BACKGROUND INFORMATION

2.1 Project Information

Contractor: MMG-TLI JV

Contract Number: W9128F18D0001

Project Name: Environmental Services Military Munitions Response Program (MMRP), Environmental Remediation Services at LHAAP-17.

Site Name: Longhorn Army Ammunition Plant, Texas

Site Location and Information:

LHAAP is a former, government-owned, contractor-operated and maintained DoD facility located in central-east Texas in the northeastern corner of Harrison County. The footprint of the former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

Various media in certain areas have been contaminated by past industrial operations and waste management practices at LHAAP. Industrial operations involved the use of secondary explosives, rocket motor propellants, and various pyrotechnics, such as illuminating and signal flares and ammunition. Explosives included 2,4,6-trinitrotoluene (TNT) and black powder. Typical composite propellants were composed of a rubber binder, an oxidizer such as ammonium perchlorate, and a powdered metal fuel such as aluminum. Pyrotechnics were generally composed of an inorganic oxidizer such as sodium nitrate, a metal powder such as magnesium, and a binder. Other materials used in the industrial operations included acids, lubricants, and solvents; particularly trichloroethene (TCE) and methylene chloride. Waste management included sanitary wastewater treatment, industrial wastewater treatment, holding/evaporation ponds, storm water drainage, sanitary and industrial waste landfills, and demolition/burning grounds. Discharges and releases to surface water, groundwater, and other secondary media have occurred from the historical operations.

LHAAP was placed on the National Priorities List on August 9, 1990. A Federal Facility Agreement (FFA), among the U.S. Army, the USEPA, and the Texas Natural Resources Conservation Commission (now the TCEQ), became effective on December 30, 1991, to address the contamination at LHAAP. The environmental cleanup actions at LHAAP are carried out under CERCLA, with the U.S. Army as the lead agency, in coordination with the USEPA, and the TCEQ, in conformance with the FFA. A dispute arose in October 2011 regarding four sites in the TO: LHAAP-16, LHAAP-17, LHAAP-001-R-001, and LHAAP-003-R-001. Dispute resolution per the FFA was resolved as documented in the USEPA’s October 2014 dispute resolution letter for these four sites.

LHAAP became inactive and excess to the Army’s needs in July 1997. Between 1998 and 2000, the Government liquidated all personal property and specific installed property. In 1999, the Army demolished several structurally unsafe buildings. The United States Fish and Wildlife Service (USFWS) requested all of LHAAP during the federal screening for Government property disposal. The Base Realignment and Closure (BRAC) Division received administrative control of LHAAP in October 2002. A Memorandum of Agreement between the Army and USFWS was signed in April 2004 (U.S. Army 2004) providing the terms and conditions of property transfer at LHAAP. Approximately 7,100 of the

8,416-acre installation have been transferred to USFWS. Army Environmental Command (AEC) is responsible for funding the Installation Restoration Program (IRP) and MMRP Programs at LHAAP. The BRAC Division holds responsibility for administrative control and transfer of property of LHAAP.

The LHAAP Information Repository is maintained at the Government Trailer on LHAAP. The LHAAP Administrative Record (AR) is maintained at the Government Trailer (hard copy and electronic) and at the Marshall Public Library (electronic only).

Additional information is available on the LHAAP Environmental Restoration Program Website: http://www.longhornaap.com/.

Site-Specific Information

Site LHAAP-17

The remediation activities required for Site LHAAP-17 are presented in an approved Final Remedial Design/Remedial Action Work Plan (RD/RAWP) prepared by Bhate Environmental Associates, Inc. (Bhate) in 2019. Bhate initiated soil remediation at Site LHAAP-17 based on this RD/RAWP but was unable to finish due to encountering the presence of munitions and explosives of concern (MEC). The MEC that Bhate encountered is comprised of two 81-millimeter (mm) Mortar M301, illuminating, nine-artillery base tracer elements, and one-M19 series rifle-launched green parachute signal.

This site was used for burning bulk TNT, photoflash powder, and reject material from Universal Match Corporation’s production processes. The site was operated as a burning ground from 1959 until 1980 and consisted of four burning pits 5 feet deep and 10 feet wide (U.S. Army Environmental Hygiene Agency [USAEHA], 1987). TNT has been detected in surface soils.

Waste residues were removed in 1984 with evidence of bulk burial of TNT occurring prior to 1954 and the area was grassed over. Volatile organic compounds (VOCs) and explosive compounds were found in the groundwater. Explosive compounds were found in the soil. Perchlorate was detected in groundwater and soil at this site in 2000. A Remedial Investigation (RI) was completed in 2002 and a Feasibility Study (FS) was finalized in 2010. A Research and Development project for enhanced in-situ bioremediation (perchlorate in soil) was started in 2002 and completed in 2004 by Planteco Environmental Consultants. The Final Record of Decision (ROD) was signed in September 2016 identifying the remedy as excavation of contaminated soil, extraction and treatment of groundwater, monitored natural attenuation (MNA) and land use controls (LUCs). A Pre-Design Investigation (PDI) Work Plan was finalized in November 2016 for resampling existing wells, installation of up to three new monitoring wells, additional soil sampling to refine extent of soil contamination, and conducting a shallow zone pumping test and results reported in the Draft Final PDI Report approved in September 2018. The Draft Final RD/RAWP was approved in March 2019.

Excavation activities began at Site LHAAP-17 in August 2019 with a goal to remove soil contaminated with TNT, 2,4-dinitrotoluene (DNT), 2,6-DNT and perchlorate at levels exceeding human health criteria and transport the contaminated soil to a suitable landfill. On August 30, 2019, halfway through excavation work, the Contractor uncovered a 4.2” mortar in Area M. Based on the history of the site, munitions were not expected to be found at Site LHAAP-17, and as a result, their hazards and disposal were not addressed in the excavation contract/task order. As a result, work was temporarily stopped while military Explosive Ordnance Disposal (EOD) responded. EOD personnel identified the ordnance as an unfuzed 4.2” illumination mortar which appeared to be empty. However, the space inside the projectile could not be fully cleared of dirt, ash, and other debris to determine if all of the expelling charge had been consumed during past disposal attempts. EOD moved the round to a 2-foot deep trench opened by excavation activities and detonated a countercharge to clear the round. Based on the results of the shot, the EOD team determined that the mortar was empty. Based on EOD findings, it was believed that this was an anomaly for the site, and subsequently the Contractor was directed to continue work. On

September 7, 2019, a second 4.2” mortar was unearthed by the excavator in Area N resulting in another work stoppage. EOD again responded to the site, and on examination, found that this second mortar projectile was completely empty. They removed it from the site. Excavation work resumed on Monday September 16, 2019, with an USACE Ordnance and Explosives Safety Specialist (OESS) on site to provide support in case further munitions were disclosed during soil removal. The OESS located and identified hundreds of munitions items within the excavation areas, and was able to determine their condition without stopping work; however, he did locate material potentially presenting an explosive hazard (MPPEH) which generated two more EOD responses. On Friday September 27, 2019, EOD was called out to dispose of two M301 81-mm illuminating mortars that the USACE OESS removed from areas M and N, but he could not ascertain their explosive safety status due to a metal baffle closing the body cavity behind the fuze wells. EOD performed field radiography on both mortars, and disposed of them by detonation in the open excavation in Area L. Based on their analysis, EOD reported that the two 81-mm mortars contained live flares. On Saturday September 28, 2019, the USACE OESS found one live M19 series rifle-launched green parachute signal mixed in with debris from 134 other signals and flares found in the soil stockpile excavated from Area H, and nine live artillery base tracer elements discovered in an accumulation of 124 tracer elements found in a soil stockpile set aside for transportation adjacent to Area K. As a result of these accumulated finds, all work was stopped at the site. All of this MEC was destroyed in a detonation on-site by EOD on September 30, 2019. The Contractor was directed by the Contracting Officer (KO) to stop work and no additional intrusive activity will be conducted at Site LHAAP-17 under the Bhate contract/task order.

2.2 Contractor Accident Experience

As reported on Occupational Safety and Health Association (OSHA) Form 300A for the year 2019, MMG and TLI had no health and safety incidents.

Table 2-1 provides information as reported on the respective 2019 OSHA Form 300A.

Table 2-1 2019 OSHA Form 300A Data

MMG-TLI JV			
Number of Cases			
Total Number of Deaths 0 (G)	Total number of cases with days away from work 0 (H)	Total number of cases with job transfer or restriction 0 (I)	Total number of other recordable cases 0 (j)
Number of Days			
Total number of days away from work 0(K)		Total number of days of job transfer or restriction 0(L)	
Injury and Illness Types			
Total number of … (M)			

(1) Injuries	0	(4) Poisonings	0
(2) Skin Disorders	0	(5) Hearing loss	0
(3) Respiratory conditions	0	(6) All other illnesses	0

2.3 Work Phases Requiring Activity Hazard Analysis

The following work phases may be used to accomplish tasks at the LHAAP-17:

- Mobilization/Demobilization
- Visual Surface Clearance
- Vegetation Removal
- DGM
- Reacquisition and Intrusive Removal of Anomalies
- Excavation with Earth Moving Machinery
- MEC Disposal Operations
- MPPEH Processing
- Soil Sampling
- Equipment Decontamination
- Installation of groundwater extraction system components
- Site Restoration

An Activity Hazard Analysis (AHA) for each task is included in Attachment 2, Site Safety and Health Plan (SSHP) Tab A of this APP.

3.0 STATEMENT OF HEALTH AND SAFETY POLICY

3.1 Health and Safety Philosophy

TLI is a division of TechLaw Consultants, Inc. (TechLaw). TechLaw and it's Divisions have developed a comprehensive Health and Safety Program to manage health and safety risks and provide compliance with local, State, and Federal regulations.

MMG-TLI JV is committed to the health and safety of our employees and success of our Health and Safety Program. We will work to provide a safe and healthful environment for all employees, contractors, and visitors to our sites and offices. Employees are an integral part of our safety and health efforts and play an active and vital role in our Health and Safety Program. Our goals are to be incident- and injury-free and to be recognized as an industry leader in health and safety.

The TechLaw Health and Safety Program has been adopted by MMG-TLI JV. Full participation by all MMG-TLI JV employees is crucial to the overall success of the program.

3.2 Health and Safety Principles

The TechLaw *Corporate Health and Safety Program Document* (TechLaw, 2020) is designed to provide guidance for employees in managing their health and safety. It is the blueprint of our comprehensive health and safety program and establishes procedures for compliance with health and safety regulations. The *Corporate Health and Safety Program Document* and its attachments shall be reviewed annually and updated as needed. It is designed to be used as the overarching document for all divisions and will be followed by the MMG-TLI JV.

Additional health and safety documents may be necessary based on project-specific work activities, such as APPs. Where applicable, plans must, at a minimum, comply with regulatory requirements. Health and Safety SOPs have been developed for a variety of topics. Policy exceptions are permitted only under specific circumstances and must be approved by the Division Director with concurrence from the Health and Safety Director (HSD). All divisions will follow the *Corporate Health and Safety Program Document* and bring to the HSD's attention newly identified health or safety issues or conditions requiring development or modification of current policies or procedures.

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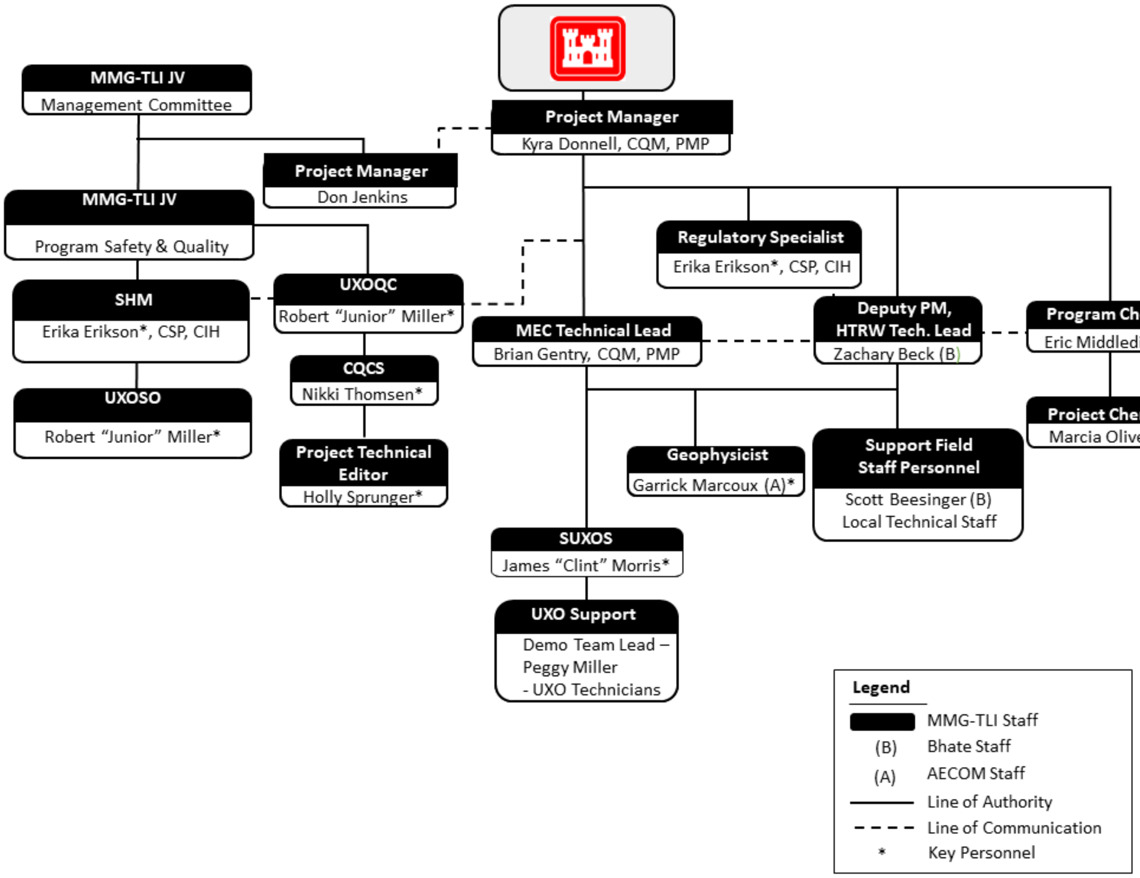
4.0 RESPONSIBILITIES

4.1 Lines of Authority

TLI and its subcontractors are responsible for implementation of this APP. Lines of authority and the responsibilities for key personnel are described below.

Figure 4-1 Project Organization Chart



Project Manager

The Project Manager (PM), Kyra Donnell represents MMG-TLI JV in all aspects of work under the contract and is responsible for:

- Providing leadership by setting an example for all site personnel through actions and words regarding the importance of proper health and safety practices and holding project staff accountable for safety performance.
- Maintaining an adequate project budget for implementation of the APP.
- Reviewing subcontractor Statements of Work for inclusion of appropriate safety provisions and expectations.
- Requiring general safety inspections during on-site activities.

- Participating in the investigation of unplanned events, high loss potential incidents, and accidents.
- Reporting unplanned events, high-loss potential incidents, and accidents to USACE and MMG-TLI JV's reporting hierarchy.
- Notifying the site personnel and safety personnel of any changes in the Scope of Work or site conditions.
- Updating the APP to address newly identified site hazards.

Safety and Health Manager

The Safety and Health Manager (SHM), Ms. Erika Erikson, CIH/CSP, will oversee the health and safety program. The SHM is responsible for:

- Approving the SSHP and this APP and any required changes.
- Approving the designated Site Safety and Health Officer (SSHO) and UXOSO.
- Reviewing all personal exposure monitoring results.
- Investigating and reporting any reported unsafe acts or conditions.

Munitions and Explosives of Concern Technical Lead

The Munitions and Explosives of Concern Technical Lead (MTL), Mr. Brian Gentry, reports directly to the Program Manager and will oversee implementation of the field program for the MMRP at LHAAP. The MTL is responsible for:

- Discussing deviations from the UFP-QAPP with the SSHO/UXOSO and Program Manager.
- Discussing safety issues with the Program Manager, SSHO/UXOSO, and field personnel.
- Assisting the SSHO/UXOSO with the development and implementation of corrective actions (CAs) for site safety deficiencies.
- Assisting the SSHO/UXOSO with the implementation of the SSHP and this APP and ensuring compliance.
- Assisting the SSHO/UXOSO with inspections of the work site for compliance with the SSHP and this APP and TLI's corporate health and safety program.

Senior Unexploded Ordnance Supervisor

The Senior Unexploded Ordnance Supervisor (SUXOS), Ray Fillion, is the senior UXO technician on-site. The SUXOS controls operations of all field teams performing MEC activities and will spend most of the day in the field monitoring their performance and helping them achieve maximum operational safety and efficiency. The SUXOS is responsible for:

- Implementing the approved plans in the field and reviewing and approving any changes.
- Supervising all UXO teams on a project, not to exceed a total of 10.
- Temporarily stopping work to correct an unsafe condition or procedure.

Unexploded Ordnance Safety Officer

The UXOSOs, report independently of project management to the SHM and the Program Quality Control Manager. The SSHO/UXOSO is responsible for:

- Implementing the APP and SSHP as well as the Explosive Site Plans (ESPs) for this project and verifying compliance with applicable safety and health requirements.

- Implementing the approved explosives and UXO safety program in compliance with all United States Department of Defense (DoD), Federal, State, and local statutes and codes.
- Analyzing UXO and explosives operational risks, hazards, and safety requirements.
- Establishing and ensuring compliance with all site-specific safety requirements for UXO and explosives operations.
- Enforcing personnel limits and safety exclusion zones for UXO clearance operations, UXO and explosives transportation, storage, and destruction.
- Conducting safety inspections to ensure compliance with UXO and explosives safety codes.
- Temporarily stopping work to correct an unsafe condition or procedure.

4.2 Policies and Procedures Regarding Noncompliance

All employees are required to comply with APP policies and procedures. MMG-TLI JV maintains the right to discipline, up to and including termination (when justified), employees at its sole discretion for serious safety infractions. Progressive disciplinary procedures are typical, but immediate termination may result from serious or egregious infractions. MMG-TLI JV anticipates that subcontractors will exercise proper disciplinary procedures, including termination/removal of employees from the project site at its sole discretion when justified. MMG-TLI JV retains the right to deny access to the site to any individual not compliant with safety requirements IAW our subcontract agreement.

4.3 Accountability

MMG-TLI JV managers are accountable for providing a safe work environment. Managers are responsible for proper staffing, training, and supplying projects with appropriate equipment. Managers provide a leadership example and set the standard for safe work habits and work environments. Annual performance reviews include assessment of project safety performance as well as individual contributions to corporate safety culture.

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5.0 SUBCONTRACTORS

5.1 Identification of Subcontractors

Subcontractors may provide support for various portions of the work phases outlined in Section 2.3 including but not limited to vegetation clearance, land surveying, DGM, and site restoration activities.

5.2 Subcontractor Responsibilities

The presence of an SSHO/UXOSO and the implementation of the APP do not relieve subcontractors of their responsibilities as employers to foster and maintain safe work habits and conditions. Subcontractors are required to comply with the OSHA and State safety regulations and the provisions of this APP and the AHAs. Subcontractor safety performance on the job will be observed, and substandard practices and conditions will be addressed immediately.

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6.0 TRAINING

6.1 Basic Requirements

Health and safety training is a prerequisite for obtaining site/activity clearance. Site workers are required to have 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training accompanied by three days of experience in the field under direct supervision of a trained, experienced supervisor. Supervisors are required to have additional supervisory training. The SSHO/UXOSO, who will be on-site during field activities will have completed the 30-Hour Construction Safety Course; have proof of five years of continuous employment experience.

At minimum, two persons on-site will have current First Aid and cardiopulmonary resuscitation (CPR) training.

Minimum qualification standards for UXO-qualified personnel (UXOQP), UXO Technicians (UXOT), Sweep Personnel (SP), and Support Workers (SWs) are shown in Table 6.1.

Table 6.1. Minimum Qualifications for UXOQP[1, 2, 3, 4], UXOT[1, 2, 3], SP[13], and SW[13]

Position Description	Training Required	Minimum MEC-related Experience	Minimum MEC-Supervisory Experience	Minimum Total EOD and MEC Experience
SUXOS	Notes 5, 7, 8, 9, 10, and 11	2 years	1 year	10 years
	Notes 6, 7, 8, 9, 10, and 11	10 years	5 years	13 years
UXOSO	Notes 5, 7, 8, and 9	1 year	0.5 year	8 years
	Notes 6, 7, 8, and 9	8 years	2 years	10 years
UXO Quality Control (QC) Specialist (UXOQCS)	Notes 5, 7, 8, 10, and 11	1 year	0.5 year	8 years
	Notes 6, 7, 8, 10, and 11	8 years	2 years	10 years
UXOT-III	Notes 5, 7, and 12	1 years	Not applicable	8 years
	Notes 6, 7, and 12	8 years		8 years
UXOT-II	Notes 5 and 12	0 years	Not applicable	1.5 years
	Notes 6 and 12	3 years		3 years
UXOT-I	Notes 5 and 12	0 years	Not applicable	0 years
	Notes 6 and 12	0 years		0 years
SP	Note 2	0 years[14, 15]	Not applicable	Not applicable
SW	Note 2	0 years[14, 15]	Not applicable	Not applicable

Notes:

1. By definition, UXOT-II and UXOT-III are UXOQP

2. Graduate of an OSHA-compliant (29 CFR 1910.120) 40-Hour HAZWOPER course.
3. Limited to performance of MEC-related activities as a UXOT or UXOQP or similar civilian government service (e.g., Ordnance and Explosives Safety Specialist [OESS]). Conduct of activities performed as an SP or SW are not considered MEC-related experience and are not counted toward the experiential requirements for UXOQP.
4. Limited to experience in UXO supervisory positions (i.e., UXOT-III, UXOQCS, UXOSO, OESS).
5. Graduate of a military Explosive Ordnance Disposal (EOD) School of the United States, Canada, Great Britain, Germany, or Australia. (EOD personnel who were terminated for gross negligence in the performance of assigned duties, a flagrant violation of EOD safety procedures or regulation, or who self-terminated the performance of EOD duties before reaching 18 consecutive months must complete the training required for a UXOT-I.)
6. Graduate of a UXOT-I Course, the EOD assistant's course or pass a comprehensive assessment.
7. Graduate of an OSHA-compliant [29 CFR 1910.120(e)(4)] 8-Hour Management and Supervisor Training course, if supervising other personnel.
8. Possesses an understanding of applicable explosives safety criteria and experience in the various phases of a munitions response to MEC or the conduct of range clearance activities, as appropriate for the operations to be performed.
9. Must have completed a 10-Hour OSHA Construction Safety and Health Training and earned a Department of Labor Construction Safety Course Completion Card.
10. UXOQCS must have either:
    a. Successfully completed training as a quality professional (i.e., International Standards Organization 9001:2015 [ISO 9001:2015] internal auditor, American Society of Quality Certified quality auditor);
    b. Possess a quality-professional certification by a recognized organization (e.g., USACE Naval Facility Engineering Command Training Course Construction Quality Management for Contractors); or
    c. Receive company- and project-specific QC training and work under the supervision of a certified quality professional.
11. UXOQCS must demonstrate an understanding of QC and quality assurance (QA) practices associated with MEC-related activities and managing and processing MPPEH, including documentation of its explosives safety status.
12. On-the-job training including, but not limited to familiarity with the process, procedures, and equipment (e.g., geophysical) used for conducting MEC-related activities.
13. Job- and site-specific training including, but not limited to, general and site-specific safety (e.g., proper use of equipment and personal protective equipment [PPE], physical, biological, and chemical hazards); explosives safety training (e.g., recognition of military munitions, 3Rs); and proper use of equipment to be used.
14. Experience as an SP or SW is not required for UXOT-I certification.
15. Activities performed as an SP or SW are not counted toward the experiential requirements for a UXOT or UXOQP.

6.2 Project Requirements

Site-specific training on the work plan and H&S plans (APP and SSHP) will be provided to persons working at the site. Site-specific training generally occurs at the commencement of site activities. Topics covered include:

- A discussion of the APP/SSHP.
- General H&S.
- Safety briefings at the beginning of a job.
- The nature of site-specific hazards.

- Site-specific Hazardous Communication training.
- Assignment and discussion of safety-related duties, including identification of the SSHO/UXOSO and contact information.
- The handling of site-specific emergencies.
- Identifying emergency contacts and locations where names of agencies and phone numbers are posted. Also, review of the site map and route to hospital is required.
- Rules and regulations for vehicle use, both on and off the site.
- A discussion/practice of specific site procedures such as decontamination.
- How to deal with third parties (visitors, the press, local community residents).
- Use of equipment.

Additional information regarding project training requirements is provided in Section 4 of the SSHP (Attachment 2). Details of the emergency response plan are provided in Section 10 of the SSHP (Attachment 2).

6.3 Periodic Training Requirements

OSHA regulations require eight hours of HAZWOPER refresher training. All personnel who continue to work on-site must complete this refresher training annually. First Aid and CPR training must be current and updated every two years.

6.4 Facility Specific Training

All personnel supporting the field effort will have completed Level I Operations Security (OPSEC) Training or will complete the training within 30 calendar days of their reporting for duty and will attend annual OPSEC awareness training thereafter. In coordination with the MMG-TLI PM, certificates of completion will be submitted to the contracting officer representative (COR) within five calendar days after completion.

Personnel mobilized to LHAAP will follow established health and safety requirements of the facility.

Personnel engaged in work at LHAAP will additionally receive installation-specific training on the local suspicious activity reporting program.

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7.0 SAFETY AND HEALTH INSPECTIONS

7.1 Inspection Responsibilities

The general inspection requirements for this project are summarized below.

Inspection	Frequency	Responsibility
General site conditions	Daily	SSHO/UXOSO
Mobile construction equipment	Daily	SSHO/UXOSO
Emergency supplies	Initial, quarterly, and restock after emergency response	SSHO/UXOSO
Fire extinguishers	Monthly	SSHO/UXOSO
Eye wash	Weekly	SSHO/UXOSO

While the individuals identified above have specific inspection responsibilities, all employees, supervisors, subcontractors, and inspectors have a duty to assess site conditions and to report unsafe conditions or work behaviors to the SSHO/UXOSO. Results of the inspections will be recorded on the safety-specific inspection forms found in Appendix G of the UFP-QAPP. Deficient inspection findings that cannot be corrected immediately will be recorded on a tracking log, which will be posted in the administrative area and updated on a daily basis.

7.2 External Inspections

If regulatory agency personnel arrive on-site to conduct an inspection, the MMG-TLI JV PM, MTL, and USACE designee (PM and/or COR) will be contacted. If a citation is issued to MMG-TLI JV or its subcontractors, a copy of the citation will be submitted to the USACE PM and/or COR to be followed by a Corrective Action or Corrective Action Plan.

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8.0 ACCIDENT REPORTING

Compilation of project exposure hours (man-hours worked) will be reported to the Contracting Officer's Representative (COR). The report will delineate the total hours recorded for each month for on-site personnel. The SUXOS will be responsible for site operations daily, which will include the compilation of man-hours worked.

Injuries, occupational illnesses, accidents, near misses, and unsafe conditions shall be reported to the SSHO/UXOSO immediately, who will advise the PM and HSD. The PM will report accidents as soon as possible, but not more than 24 hours afterwards to the USACE PM and/or COR (except as noted below).

In addition to the reporting requirements above, MMG TLI JV will report one or more of the following:

- Property damage (exceeding $5,000)
- Days Away injuries
- Days Away Illnesses
- Restricted/Transfer Injuries

With support from the HSD, each instance will be investigated by the SSHO/UXOSO. Injuries will be documented on the Injury and Illness Incident Report Forms, OSHA Forms 300/301 (or equivalent), and USACE Form 3394 for recordable occupational injuries and illnesses. These forms are attached in the SSHP (Attachment 2), Tab C. Findings from the ensuing investigation will be reported to the USACE PM and/or COR no later than five working days following the accident. Corrective actions will be implemented as soon as reasonably possible.

Immediate notification will be provided for accidents that result in one or more of the following outcomes:

- Fatalities/illness
- Permanent total disabling injury/illness
- Permanent partial disabling injury/illness
- Three or more individuals become ill or have a medical condition that is suspected to be related to a site condition (i.e., hazardous or toxic agent)
- One or more persons hospitalized as inpatients as a result of a single occurrence
- $500,000 or greater accidental property damage

Per OSHA requirements, fatalities will be reported within eight hours, and amputation, loss of an eye, or admission to a hospital will be reported within 24 hours.

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9.0 MEDICAL SUPPORT

9.1 Emergency Information

Project emergency contact information is presented in SSHP (Attachment 2) Table 10-2. The hospital route map is presented as SSHP (Attachment 2) Figure 10-1. A copy of the hospital route map will be readily available in each site vehicle that may be used to transport accident victims to the hospital.

9.2 Emergency Response Team

The emergency response team will consist of employees who assume the following roles:

- Emergency care provider(s): Provide first aid/CPR as needed.
- Communicator: The role of the communicator is to maintain contact with appropriate emergency services, providing as much information as possible, such as the number injured, the type and extent of injuries, and the exact location of the accident scene. The communicator should be located as close to the scene as possible in order to transmit to the emergency care providers any additional instructions that may be given by emergency services personnel in route.
- On Scene Incident Commander: The On-Scene Incident Commander (usually the SSHO/UXOSO) will survey and assess existing and potential hazards, evacuate personnel as needed, and contain the hazard. Follow up responsibilities include replacing or repairing damaged equipment, documenting the incident, and notifying appropriate personnel/agencies described under incident reporting. It also includes reviewing and revising site safety and contingency plans as necessary.

9.3 Medical Emergencies Response Plan

At least two on-site employees will hold a current certificate in first aid/CPR which must include hands-on training.

If a medical emergency exists, request an ambulance as soon as possible. Rescuers must be appropriately protected from potential hazards they may encounter during the rescue. While awaiting the ambulance, stabilize the injured and decontaminate the injured person if necessary. Extricate the victim only if the environment is NOT dangerous or unsafe. Perform first aid/CPR as necessary.

When emergency services personnel arrive, communicate all first aid activities that have occurred. Transfer responsibility for care of the injured/ill to the emergency services personnel. If the rescuers cannot safely enter the work zone to transport the victim, extricate the victim to the area where the rescuers can attend to the victim. Depending on the injuries, extrication to an appropriate rescue personnel approach site may require use of medical equipment (back boards, collars, wraps) provided by the rescue personnel.

The following items and emergency response equipment will be located within easy access at all times:

- First aid kit and Bloodborne Pathogen Protection kit;
- A 15-minute eyewash (required if corrosives are present) and an appropriate amount of portable sterile eyewash bottles for flushing foreign particles or contaminants out of eyes (the SSHO/UXOSO will demonstrate the proper operation of the unit(s) prior to the start of work);
- Emergency phone numbers list;
- Portable radios for emergency communications in remote areas;

- Drugs, inhalants, or medications will not be included in the first aid kit; and
- Route to hospital.

Supplies will be reordered as the supplies are used. When work is in progress, a quarterly inventory will be done on the first aid kit and Bloodborne Pathogen Protection kit contents and supplies re-ordered as needed.

10.0 PERSONAL PROTECTIVE EQUIPMENT

The protective equipment ensembles selected for this project are anticipated to provide protection against the types and concentrations of hazardous materials that may potentially be encountered during field operations. However, no protective garment, glove, or boot is resistant to all chemicals at any concentration; in fact, chemicals may continue to permeate or degrade a garment even after the source of the contamination is removed.

To obtain optimum usage from PPE, personnel should inspect safety gear both prior to and during use for imperfect seams, non-uniform coatings, tears, and poorly functioning closures.

The minimum PPE for site personnel includes:

- High visibility vest (when working around heavy equipment)
- Hardhat (when overhead hazards exist)
- Safety glasses with side shields (or impact-resistant goggles)
- Safety-toed boots
- Ear protection in the vicinity of noisy equipment/operations
- Work gloves (when pinch points exist)
- Nitrile coated disposable gloves (when handling propellant/bulk explosives, or as needed)
- Snake chaps or knee-high snake boots worn in conjunction with trousers and long-sleeved shirts (in areas where there is exposure to poisonous snakes or lizards)

Refer to Table 10-1 for task-required minimum PPE. Section 7 of the SSHP (Attachment 2) provides additional information regarding the PPE requirements for this project. The level of protection worn by site personnel will be enforced by the SSHO/UXOSO.

Table 10-1. Minimum Protective Clothing/Equipment

Task	Minimum Protective Clothing/Equipment
1. General Site-Wide Hazards	Safety glasses, safety-toed boots, work gloves
2. Mobilization/Demobilization	Safety glasses, safety-toed boots, work gloves
3. Decontamination	Safety glasses, safety-toed boots, work gloves, nitrile gloves, splash protection as needed
4. Remediation-Derived Waste (RDW) Management	Safety glasses, safety-toed boots, work gloves, nitrile gloves
5. Earth Moving Machinery	Safety glasses, safety vest, safety-toed boots, work gloves, hardhat, hearing protection
6. Vegetation Clearance	Safety glasses, safety vest, safety-toed boots, work gloves hearing protection, and long-sleeved shirt
7. Reacquisition and Intrusive Removal	Safety glasses, safety-toed boots, work gloves, long-sleeved shirt
8. Soil Sampling	Safety glasses, safety-toed boots, work gloves, nitrile gloves

Task	Minimum Protective Clothing/Equipment
9. MEC Disposal Operations	Safety glasses, safety-toed boots, work gloves
10. MPPEH Processing	Safety glasses, safety-toed boots, work gloves
11. Land Surveying	Safety glasses, safety-toed boots, work gloves
12. Site Administration	Safety glasses, safety-toed boots, work gloves
13. Surface Clearance	Safety glasses, safety-toed boots, work gloves, long-sleeved shirt
14. DGM	Safety glasses, safety-toed boots, work gloves
15. Handling Propellant/Bulk Explosives Operations	Safety glasses, safety-toed boots, work gloves, nitrile coated gloves, static resistant bags
16. Removal of Bulk Inert Material	Safety glasses, safety-toed boots, work gloves
17. Fence Removal Operations	Safety glasses, safety-toed boots, work gloves
18. MEC Propellant Burn Disposal Operations	Safety glasses, safety-toed boots, work gloves
19. Installation of groundwater extraction system components	Safety glasses, safety-toed boots, work gloves

Notes:

- Hearing protection, safety vests, and hard hats will be worn as necessary, depending on the requirements of the equipment being used, or at the discretion of the SSHO/UXOSO.
- Snake chaps or knee-high snake boots worn in conjunction with trousers and long-sleeved shirts in areas where there is exposure to poisonous snakes or lizards.

Exposure to poisonous snakes is a possibility while performing tasks at LHAAP. The following section IAW EM 385-1-1 will be observed when the potential for snake exposure exists:

*"Section 06.E.02***:** *In areas where there is exposure to poisonous snakes or lizards, employees shall be required to:*

a. Wear snake chaps or knee-high snake boots worn in conjunction with trousers and long-sleeved shirts;
b. Be trained in recognition of the snakes and their common nesting habits, aggressiveness, etc.; and
c. Be trained in the proper first aid procedures for bites."

11.0 REQUIRED PLANS, PROGRAMS AND PROCEDURES

Applicable plans, programs, and procedures required by EM 385-1-1 are summarized below:

Table 11-1 Plans (Programs, Procedures) Listed in EM 385-1-1

PLANS (PROGRAMS, PROCEDURES) LISTED IN EM 385-1-1			
EM 385 1-1 Section	**Plan Title**	**EM 385 1-1 Reference**	**Required for LHAAP Activities and SSHP Reference**
Appendix A, 3.i.	Fatigue Management Plan	01.A.20	**Yes, 5.3.1**
Appendix A, 3.i.	Emergency Plans: (1) Procedures and Tests (2) Spill plans (3) Firefighting plan (4) Posting of emergency telephone numbers (5) Man overboard/abandon ship (6) Medical Support (7) Emergency Response Planning (8) Inclement weather	(1) 01.E.01 (2) 01.E.01, 06.A.02 (3) 01.E.01, Section 19 (4) 01.E.05 (5) Section19.A.04 (6) Section 03.A.02; 03.D (7) 01.E.01 (8) 01.E.01	(1) No **(2) Yes, 10.1.4** (3) No **(4) Yes, Table 10-1, Table 10-2** (5) No **(6) Yes, Figure 10-1, Table 10-2** **(7) Yes, 10.1** **(8) Yes, 10.2**
Appendix A, 3.i.	Plan for prevention of alcohol and drug abuse	Section 02	**Yes, 4.7.2**
Appendix A, 3.i.	Site Sanitation/Housekeeping Plan	Section 02.B	**Yes, 4.7**
Appendix A, 3.i.	Medical Support Agreement	03.A.01; 03.A.03	No
Appendix A, 3.i.	Blood-Borne Pathogen Program	03.A.05	**Yes, 5.4.7**
Appendix A, 3.i.	Exposure Control Plan	03.A.05	No
Appendix A, 3.i.	Automatic External Defibrillator (AED) Program	03.B.04	No
Appendix A, 3.i.	Site Layout Plans	04.A	No
Appendix A, 3.i.	Access/Haul Road Plan	04.B	No
Appendix A, 3.i.	Hearing Conservation Program	05.C	**Yes, 6.2**
Appendix A, 3.i.	Respiratory Protection Plan	05.G	No
Appendix A, 3.i.	Health Hazard Control Program	06.A	No
Appendix A, 3.i.	Hazard Communication Program	06.B.01	**Yes, 4.3**
Appendix A, 3.i.	Process Safety Management Program	06.B.04	No
Appendix A, 3.i.	Lead Compliance Plan	06.C.02 & specifications	No
Appendix A, 3.i.	Asbestos Abatement Plan	06.C.03 & specifications	No
Appendix A, 3.i.	Radiation Safety Program	06.F	No

PLANS (PROGRAMS, PROCEDURES) LISTED IN EM 385-1-1			
EM 385 1-1 Section	**Plan Title**	**EM 385 1-1 Reference**	**Required for LHAAP Activities and SSHP Reference**
Appendix A, 3.i.	Abrasive Blasting Procedures	06.I.01	No
Appendix A, 3.i.	Heat Stress Monitoring Plan (HSMP)	06.J.02	**Yes, 4.7.5, 5.3.11, Tables 5-1 and 5-2**
Appendix A, 3.i.	Cold Stress Monitoring Plan (CSMP)	06.J.04	**Yes, 4.7.5, 5.3.12**
Appendix A, 3.i.	Indoor Air Quality Management	06.L	No
Appendix A, 3.i.	Mold Remediation Plan	06.L.04	No
Appendix A, 3.i.	Chromium (VI) Exposure Evaluation	06.M	No
Appendix A, 3.i.	Crystalline Silica Evaluation	06.N.02	No
Appendix A, 3.i.	Lighting Plan for Night Operations	07.A.06	No
Appendix A, 3.i.	Traffic Control Plan	08.C.05	**Yes, 5.3.6**
Appendix A, 3.i.	Fire Prevention Plan	09.A.01	**Yes, 5.3.10, Table 10-1, Table 10-2**
Appendix A, 3.i.	Wild Land Fire Management Plan	09.L	No
Appendix A, 3.i.	Hazardous Energy Control Program & Procedures	12.A.01	No
Appendix A, 3.i.	Standard Pre-Lift Plan—Load Handling Equipment	16.A.03	No
Appendix A, 3.i.	Critical Lift Plan—Load Handling Equipment	16.H	No
Appendix A, 3.i.	Naval Architectural Analysis—Load Handling Equipment (Floating)	16.L	No
Appendix A, 3.i.	Floating Plant Inspection and Certification	19.A.01	No
Appendix A, 3.i.	Severe Weather Plan for Marine Activities	19.A.03	No
Appendix A, 3.i.	Emergency Plan for Marine Activities	19.A.04	No
Appendix A, 3.i.	Man Overboard/Abandon Ship Procedures	19.A.04	No
Appendix A, 3.i.	Float Plan for Launches, Motorboats, and Skiffs	19.F.04	No
Appendix A, 3.i.	Fall Protection and Prevention Plan	21.D	No
Appendix A, 3.i.	Demolition/Renovation Plan (to include engineering survey)	23.A	No
Appendix A, 3.i.	Rope Access Work Plan	24.H	No
Appendix A, 3.i.	Excavation/Trenching Plan	25.A.01	No

PLANS (PROGRAMS, PROCEDURES) LISTED IN EM 385-1-1			
EM 385 1-1 Section	**Plan Title**	**EM 385 1-1 Reference**	**Required for LHAAP Activities and SSHP Reference**
Appendix A, 3.i.	Fire Prevention and Protection Plan for Underground Construction	26.D.01	No
Appendix A, 3.i.	Compressed Air Work Plan for Underground Construction	26.I.01	No
Appendix A, 3.i.	Erection and Removal Plan for Formwork and Shoring	27.C	No
Appendix A, 3.i.	Precast Concrete Plan	27.D.01	No
Appendix A, 3.i.	Lift-Slab Plans	27.E	No
Appendix A, 3.i.	Masonry Bracing Plan	27.F.01	No
Appendix A, 3.i.	Steel Erection Plan	27.F.01	No
Appendix A, 3.i.	Explosives Safety Site Plan (ESSP)	29.A	**Yes, ESP Under Separate Cover**
Appendix A, 3.i.	Blasting Plan	29.A; 26.J	**Yes, 2.2.2, Explosives Management Plan (EMP) and SOPs Under Separate Cover**
Appendix A, 3.i.	Dive Operations Plan	30.A.14, 30.A.16	No
Appendix A, 3.i.	Safe Practices Manual for Diving Activities	30.A.15	No
Appendix A, 3.i.	Emergency Management Plan for Diving	30.A.18	No
Appendix A, 3.i.	Tree Felling and Maintenance Program	31.A.01	Yes, 2.2.2.3
Appendix A, 3.i.	Aircraft/Airfield Construction Safety & Phasing Plan (CSPP)	32.A.02	No
Appendix A, 3.i.	Aircraft/Airfield Safety Plan Compliance Document (SPCD)	32.A.02	No
Appendix A, 3.i.	Site Safety and Health Plan for Hazardous, Toxic, and Radioactive Waste (HTRW)	33.B	**Yes, Accident Prevention Plan, Attachment 2 Site Safety and Health Plan**
Appendix A, 3.i.	Confined Space Entry Procedures	34.A.05	No
Appendix A, 3.i.	Confined Space Program	34.A.06	No

These plans, programs, or procedures are included in the SSHP, which also addresses, utility avoidance, heavy equipment operation, and safe operation of power and hand tools, material lifting, biological hazards, dust control, and work zones.

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12.0 RISK MANAGEMENT PROCESSES

Project-specific hazards and controls have been evaluated through AHA forms for each major phase of work. The AHA assesses physical, chemical, and biological hazards associated with each work phase and subordinate tasks. The AHA process is documented in Section 5 of the SSHP (Attachment 2). Tab A of the SSHP contains the detailed AHA information for each hazard, including the risk assessment codes associated with each task including any AHAs submitted to MMG-TLI-JV by subcontractors.

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13.0 REFERENCES

Department of Defense Explosive Safety Board. 2020. *Technical Paper 18, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*. June.

Occupational Safety and Health Administration. 29 Code of Federal Regulation 1910, *Occupational Safety and Health Standards*.

TechLaw Consultants, Inc., 2020. *Corporate Health and Safety Program Document*, September.

United States Army Corps of Engineers, 2014. Engineering Manual 385-1-1, *Safety and Health Requirements*. November.

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ATTACHMENT 1

PLAN PREPARER AND SAFETY PERSONNEL RESUMES

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Owens Carter, SMS

Safety and Health Officer

PROFESSIONAL EXPERIENCE	Years of Relevant Experience: 40.0 Years with TLI Solutions, Inc.: 4
EDUCATION	BS, Environmental Health, Bowling Green State University, AA, Applied Sciences, Bowling Green State University,

BASIC QUALIFICATIONS

Mr. Carter is a senior level H&S, radiological engineering professional with more than 37 years of experience in the nuclear power generating industry, U. S. Department of Defense (DoD) and U.S. Department of Energy (DOE) Environmental Management projects. He has extensive experience working with H&S programs in a technical/supervisory role and as a Radiological Engineer and Radiation Protection Technician. His DOE experience is primarily focused on environmental remediation projects, including waste characterization, decontamination and demolition of contaminated facilities, and soils remediation. Mr. Carter has been instrumental in turning poor-performing programs into top-performing programs that are compliant with DOE and U.S. Nuclear Regulatory Commission (NRC) Environment, Safety, and Health (ES&H) and Quality requirements.

EXPERIENCE

Mr. Carter's experience includes the following projects:

➢ TLI, Knoxville, Tennessee. 2015–Present. Mr. Carter is assigned as the SSHO/Radiological Engineer for TLI overseeing H&S requirements for various different projects and provide any technical support. His duties include discussing potential H&S hazards with the PM and field personnel, conducting daily site safety and health inspections, supervising technicians performing Industrial Hygiene (IH)/radiological surveys and monitoring, reviewing all personal exposure monitoring results, writing and approving Health and Safety Plans, and providing a means for employees to communicate safety issues to management in a discreet manner. He is also assigned as the Site Quality Control Manager (SQCM) and Field Supervisor for some of the projects. The Field Supervisor’s duty is to ensure that the environmental remediation project work is performed IAW the design package. Mr. Carter is responsible for construction quality assurance, laboratory coordination, data tracking, data interpretation and daily reports. The SSHO is the first point-of-contact for all of the project’s H&S matters. The SSHO is authorized to suspend TLI field activities at any time in response to H&S-related hazards or concerns.

Project assignments include:

•Solid Waste Management Unit (SWMU) 56. Responsible for remediation at PCD, Pueblo, Colorado. The remedy for SWMU 56 is implemented IAW the Colorado Department of Public Health and the Environment (CDPHE) Permit and the procedures detailed in the work plan. The remedy consists of asbestos abatement; building demolition and off-site disposal of building debris; concrete slab removal and treatment/disposal; excavation and off-site treatment/disposal of mercury contaminated soil; and site restoration.

•SWMU 60 at PCD, Pueblo, Colorado. Responsible for the package for the SWMU 60 pershing missile disposal site and asbestos landfill area environmental remediation activities. The SOW included conducting corrective measures for a landfill where missile debris and asbestos-containing materials were disposed. Work activities included temporary erosion and sediment control measures, dust control, land surveying performed during various stages of the construction process, excavation and hauling of borrow soil, foundation grading, placement of water storage layer, placement of erosion layer and revegetation, surface water run-on and run-off control, and installation of fencing.

•Remedial Investigation (RI) and Report for Project B (Yellow Sites) at Tyson Research Center (TRC); USACE Kansas City District; St. Louis, Missouri; provided site safety support for various work activities.

•East Tennessee Technology Park (ETTP) Switchyard project, ETTP Oak Ridge, Tennessee. The project managed all work activities IAW plans, work packages, and coordination with site contractor and support subcontractors and vendors. The following work-related activities were performed: soil/water sampling, decontamination activities, construction remediation/restoration activities, site characterization, soil and water sampling, IH sampling, waste management activities, transportation activities and other miscellaneous mobilization and demobilization activities as needed by the project.

•Y-12 Mercury Treatment Facility (MTF) Geotechnical Investigation, OF200 Project, Y-12 Complex, Oak Ridge, Tennessee. The objective of this Investigation is to provide details on the geotechnical characterization needed to support design of the Outfall 200 MTF. Geotechnical data and samples collected under this investigation will provided sufficient geotechnical data to support treatment facility design and construction. The scope of the geotechnical characterization consists of well drilling, sample collection, groundwater level measurements, testing within the unconsolidated soil above the bedrock, and coring of the bedrock at selected locations.

➢EXELON Nuclear, Clinton, Illinois, 2014–2015. Served as a Rad Protection (RP) Technical Specialist at Clinton Power Station in Clinton, Illinois. Accountable for implementing the station radiation protection technical programs, such as; dosimetry, respiratory protection, self-assessments and Corrective Actions Program (CAP) processes, procedure implementation, safety observations, backup shipping specialist, RP contract administration, Performance Indicator (PI) Analyst, and other programmatic processes as assigned.

➢ETTP and K-25 Decontamination and Decommissioning (D&D) projects, Bechtel Jacobs and UCOR/Restoration Services, Inc., Oak Ridge, Tennessee. 2003–2013. Served in the ES&H department as a Project Health Physicist and Radiological Engineer coordinating the deployment of radiation protection resources and overseeing project activities and the Radiological Control (RADCON) subcontractor to ensure work is performed IAW the Radiological Protection and RADCON Programs. Managed a staff of up to 85 personnel. Developed project as low as reasonably achievable (ALARA) goals, survey and release plans for buildings and equipment disposal using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) approach, and tracked overall project performance for ALARA. As the ALARA Planner provided technical support for work planning to ensure work was planned and performed in a manner to ensure workers' H&S. Qualified as a Safety Advocate to provide general H&S support on an as-needed basis to the projects. Other responsibilities included providing safety topics to staff for use during meetings, making key technical field decisions, and performing ES&H audits and assessments. The D&D project involved over 350 building and facility demolitions including slab removal for some of the facilities, the removal of massive components and equipment, hazardous materials and waste disposition.

➢Portsmouth Gaseous Diffusion Plant, Bechtel Jacobs, Piketon, Ohio, 2002–2003. Served as a Project Health Physicist and Radiological Engineer providing technical and day-to-day direction to the RADCON subcontractor, including approval of Radiological Control Technician staffing, making key technical field decisions, executing actions in the RADCON functional performance documents, coordinating the deployment of radiation protection resources, and performing audits and assessments. Served as the ALARA Planner providing technical support to project planners to ensure work was planned and performed in a manner to ensure workers' H&S. Managed a staff of up to 50 personnel. Developed survey and release plans for buildings and equipment disposal using the MARSSIM approach. Responsible for tracking overall project RADCON performance. Also, qualified as a Safety Advocate to provide general H&S support on an as-needed basis to the projects.

➢AMERGEN LLC, Clinton, Illinois, 1984–2002. Served in the following capacities at the AMERGEN nuclear power station in Clinton, Illinois: Radiological Engineer, Supervisor of Radiological Programs, Industrial Hygienist / Respiratory Protection Specialist, and Radiation Protection Technician.

-Radiological Staff Engineer included monitoring and assessing the radiological impact of plant operations on the environment by providing technical oversight of the Radiological Environmental Monitoring Program (REMP). The REMP involves collecting samples of the air, surface water and public well-water, grass, meat, soil, milk, shoreline and bottom sediments, aquatics and vegetation surrounding the Clinton Power station. All samples were analyzed by an independent scientific laboratory. Results from the samples were made available to the public through the Annual Radiological Environmental Operating Report and filed with the NRC. Review of chemistry effluent sample analysis, collection of and review of monitor and flow data from plant monitoring systems, calculation of radioactive material discharges and resulting dose, writing technical reports and procedures, performing assessments and audits, assisting Dosimetry in dose investigations, calculating off-site doses, and supervising technicians. Directed supervision of bargaining unit personnel responsible for sample collection, storage, analysis and shipment; directed and reviewed laboratory analyses activities; and maintained emergency laboratory analysis capability. Other responsibilities included managing the plant's Control of Chemical Program and Drum Control Program.

-Supervisor of Radiological Programs included shipping radiological and non-radiological waste; budget management; minimizing waste; managing hazardous materials; updating and maintaining the company's Material Safety Data Sheet (MSDS) program; maintain the Spill Prevention, Control, and Countermeasure (SPCC) Plans; processing and disposal of radiological waste; and supervising hazardous material and Health Physicist (HP) technicians.

-Respiratory Protection Specialist included implementing a respiratory protection program that satisfied all regulatory requirements and company commitments, determining appropriate protective measures/equipment and engineering controls, writing procedures and work instructions, supervising respiratory protection technicians, and serving as the plant's Industrial Hygienist.

-Radiation Protection Technician responsibilities included providing radiation protection job coverage, surveys, and waste reduction techniques. Work coverage consisted of monitoring radiological conditions prior to performing work, during work activities, and at the completion of job; writing procedures and technical documents; calibrating and repairing instruments used for personnel monitoring and process plant monitoring; issuing, repairing, and servicing respiratory protection equipment; monitoring confined spaces; and performing ALARA preoperational reviews. Also served on the plant fire brigade and trained as an EMT for plant emergency response.

➢ DoD, Portsmouth, Virginia, 1981–1984. Radiological Controls Technician (RCT) for the DoD at a naval shipyard. Responsibilities included providing radiation protection job coverage, surveys, and waste reduction for nuclear submarine and surface craft overhauls. Work coverage consisted of monitoring radiological conditions prior to performing work, during work activities and completion of job. All RCTs were trained to radiation protection procedures for regulatory compliance to ensure no personnel exposures limits were exceeded, no unplanned exposures were encountered, and that no radiation was spread to the public and environment.

➢ EPA at the Plum Brook Station in Sandusky, Ohio, 1980–1981. Environmental Scientist responsible for conducting noise enforcement testing to determine whether manufacturers subject to EPA regulations were complying. Provided voluntary noise testing of trucks and compressors in the field at truck stops and at the noise testing facility. Performed several audits of manufacturers at their facilities to ensure noise levels met regulatory limits prior to being distributed to dealerships. Knowledge and skills to set up, check out, and calibrate electronic instruments for noise measurements.

➢Ohio Department of Natural Resources, Huron, Ohio, 1979–1980. Preserve Officer Intern involved in baseline research monitoring of estuary. Performed soil and water quality analysis, mapping of estuary, animal and vegetation identification, and routine maintenance work. Collected and analyzed data to draw meaningful conclusions for future references. Assisted in management of area and conducting tours to the public.

RELATED EXPERIENCE

➢RCT responsibilities included monitoring contamination control points to prevent the spread of radioactive contamination to adjacent uncontrolled areas. Performed surveys such as radiation and contamination surveys and collected air samples and water samples for analysis. Performed inspection of installed containments to ensure integrity. Calibrated instruments, made mechanical joint bag inspections, poly bottle surveillance for all installed poly bottles. Covered jobs in the reactor compartments during submarine and surface-craft overhaul/repair (i.e., pressurizer, main coolant pumps, panel hook-up valve cut-out, installation of test equipment, etc.). Covered other jobs such as transfer of radioactive liquids (tank to tank, tank to building to process). Involved in inspecting radioactive waste and preparing such waste for proper shipment.

➢Radiological Staff Engineer included monitoring and assessing the radiological impact of plant operations on the environment by providing technical oversight of the REMP. This program is an extensive program of sampling, measuring, and analyzing that was instituted to monitor the radiological impact of reactor operation on the environment. The scope of the program includes the monitoring of five environmental compartments: direct radiation, atmospheric, aquatic, terrestrial environments, ground and surface water. Program objectives include: identification, measurement and evaluation of existing radionuclides in the environs of the plant and fluctuations in radioactivity levels which may occur; evaluation of the measurements to determine the impact on the local radiation environment; collection of data needed to refine environmental radiation transport models used in off-site dose calculations; verification that radioactive material containment systems are functioning to minimize environmental releases to levels that are ALARA; and to demonstrate compliance with regulations and the plant’s Off-Site Dose Calculation Manual (ODCM). Samples are sent to a contractor laboratory for analysis and the analytical results were reported monthly for review and validation, to ensure required specifications are met, and identification of any anomalies. Annually, over 1,500 environmental samples were taken with over 2,000 analyses were performed on the samples.

➢Respiratory Protection Specialist duties included identification of all applicable regulations and standards; selection of equipment and determination of inventory sizes; determination of appropriate protective measures/equipment and engineering controls; determination of training requirements for workers and technicians; development and maintenance of procedures and establishment of quality and control checks; daily review of equipment, logs, and records; confined space monitoring and review of entry records; field observations of equipment usage; observation of repair and inspection activities; Grade D air sampling; and inspection and maintenance of all respiratory protection equipment including portable ventilation units and breathing air compressors.

EMPLOYMENT	Company	Title	Date Range
	TLI	Expert Consultant	2016–Present
	SUMMIT Technical Resources, Inc.	Health and Safety Officer / Radiological Engineer	2015
	Exelon Nuclear	Radiation Protection Technical Specialist	2014–2015
	Bechtel Jacobs LLC/UCOR LLC	Project Health Physicist/Radiological Engineer	2003–2013
	Bechtel Jacobs LLC	Project Health Physicist	2002–2003
	AMERGEN LLC	Radiation Protection Technician	1984–2002
	AMERGEN LLC	Radiological Engineer	1984–2002
	AMERGEN LLC	Industrial Hygienist / Respiratory Protection Specialist	1984–2002
	AMERGEN LLC	Supervisor of Radiological Programs	1984–2002
	DoD	Radiological Controls Technician	1981–1984
	EPA	Environmental Scientist	1980–1981

CERTIFICATIONS	➢ Certified Safety Management Specialist (SMS) by the Board of Certified Safety Professionals (BCSP) Cert.# SMS-433 ➢ Computer Programming Certification ➢ Federal Emergency Management Agency (FEMA) Certificate of Achievement for National Incident Management System ➢ Certificate of Completion for Internal Air Transport Association (IATA) of Radioactive Materials Training ➢ Certificate of Completion for Load Securing for Radioactive Material Training ➢ Certificate of Completion for U.S. Department of Transportation (DOT)/NRC Radioactive Waste Packaging, Transportation, and Disposal

Erika Erikson, CIH, CSP

HEALTH AND SAFETY MANAGER

PROFESSIONAL EXPERIENCE	Years of Relevant Experience: 30 Years with TechLaw Consultants, Inc : 2
EDUCATION	JD, Texas Wesleyan University School of Law (2003) MPA, Public Administration (1995), MA, Interdisciplinary Studies (1990), MS Environmental Science (1988), University of Texas-Dallas BS, Chemistry/BA, Philosophy, (1985) North Texas State University

BASIC QUALIFICATIONS

Ms. Erikson is Corporate Health & Safety Director for TechLaw Consultants, Inc. Her duties include developing and implementing the corporate Health and Safety program and responsibility for corporate-wide daily activities in medical surveillance, training, respiratory protection, and record keeping programs for compliance with OSHA regulations. She also reviews site-specific Health and Safety Plans (HASPs) and H&S Evaluation Checklists prepared for various field activities by TechLaw offices.

She is a CIH, CSP, and licensed attorney with several years of experience as an ES&H professional, with expertise in manufacturing and consulting, featuring a broad background in: regulatory compliance; industrial hygiene; ES&H program development, review and implementation; ES&H review of construction/remodeling projects; project management; remediation strategies; cost containment; ES&H auditing, training and review of new products and processes; and laboratory safety. She is proficient in reading, interpreting, and implementing regulatory requirements at the city, State, and Federal levels.

EXPERIENCE

Ms. Erikson has held several management and oversight positions, with extensive experience and expertise in environmental rules and regulations, corporate safety and health, industrial safety and hygiene, security, and the law. Examples of her experience include:

- As a Project Associate for a legal services firm, she identified, articulated, and supported key issues and players in various documents for production in legal proceedings; understood and applied tagging guidelines to documents reviewed; understood and applied privilege guidelines as they applied to each project and used specialized software for review.

- As Director of ES&H for a manufacturing firm, she administered all ES&H programs and policies as well as conducted internal audits and recommended improvements, for four facilities with more than 500 employees. She also coordinated with other departments to review capital projects, proposed changes to existing processes, and evaluated new products and/or processes to prevent potentially fatal situations. Her achievements included: assisting with the startup of a 5,000-square-foot research and development facility from an ES&H perspective; overseeing and reviewing security procedures for a Customs-Trade Partnership Against Terrorism facility; overseeing a $1.2 million remediation of a research and development facility to prepare for re-occupancy; coordinating the development of a Chemical Hygiene Plan (CHP) for six research laboratories and two quality control laboratories to reduce the potential for adverse events; and obtaining a Positive Use Determination and associated tax relief for air pollution control equipment valued at $1.5 million, resulting in an estimated $11,000/year tax savings for the 20-year life of the equipment.

- As an environmental attorney for a law firm, she assisted in managing the environmental audits of more than 90 oil and gas sites under the Texas Audit Protection Act to forego enforcement action. Other achievements included: managing the due diligence process for the acquisition or foreclosure of numerous former gas stations, including a portfolio of over 50 sites nationwide; coordinating the preparation and submission of several Municipal Setting Designations, including one application that included over 50 properties and 40 owners; assisting in negotiating global consent decrees for three refinery sites; and developing and drafting an environmental due diligence process to meet Federal Deposit Insurance Corporation guidelines and prevent non-compliance.

- Responsible for compliance with all applicable health, safety, and environmental regulations as an ES&H Manager for a pesticide formulation facility with 100 full-time employees and up to 40 temporary employees. Helped reduce waste disposal costs by 80% for Class 2 waste, oversaw a $4.1 million remediation project due to historical operations, and assisted in the design, coordination, permitting, and construction of a facility to manufacture pesticides.

- As a private ES&H consultant, she provided health and safety consulting services to various clients including preparation of site-specific health and safety plans, performing emergency response, conducting training courses, monitoring and observation of construction sites, and review and evaluation of reports.

- As a Disaster Assistance Employee/National Safety Cadre for FEMA, she provided health and safety support for federal employees assigned to disaster field offices and fixed facilities. Also evaluated buildings used for field offices and fixed facilties, made recommendations regarding health and safety issues, and maintained health and safety records.

- As a Corporate Industrial Hygienist for a manufacturing facility, she provided technical support to three secondary lead smelters, an oil and grease manufacturing facility, an anode manufacturing facility, and an analytical/research and development laboratory. Also oversaw the biological, air and industrial hygiene monitoring programs for all facilities and revised and maintained health and safety programs for all facilities.

- As a Corporate Health and Safety Compliance Manager for an engineering firm, she developed, evaluated, and maintained all health and safety programs and provided technical support to over 20 offices with more than 700 employees. Also served as Senior PM of Asbestos Management Team for a $2 million project in Albuquerque, New Mexico. Developed and implemented Operations and Maintenance Programs for various clients as an industrial hygienist, providing training for clients as well as in-house personnel, performing various types of surveys, conducting IH sampling, preparing proposals and reports, and managing projects.

- As a Laboratory Manager/Field Technician, she served as a laboratory manager for the analysis of both air and bulk asbestos samples with two in-house analysts and up to five field analysts. Monitored asbestos abatement and conducted other industrial hygiene sampling, surveyed various types of sites, and prepared proposals and reports.

- Served as a Contract Chemist at BASF Chemical Division, Analytical Services Group, preparing all samples for metals analysis, performing atomic absorption analyses, including wastewater per EPA requirements, and method development for atomic absorption and wet analyses. Also performed QA/QC duties using spectrophotometers and wet analyses.

EMPLOYMENT	**Company**	**Title**	**Dates**
	TechLaw Consultants, Inc.	Corporate Safety & Health Director	2018–Present
	Level 2 Legal Solutions	Project Associate	2017–2018
	Fritz Industries	ES&H Director	2014
	Guida, Slavich & Flores, P.C.,	Environmental Attorney	2004–2013
	Wellmark International	Manager, Health, Safety and Environment, and Active Ingredient Manufacturing	1998–2004
	Self-Employed ES&H Consultant	Owner-Consultant	1995–1999
	Disaster Assistance Employee	Federal Emergency Management Agency	1996–2000
	RSR Corp.	Corporate Industrial Hygienist	1996–1998
	BCM Engineers	Corporate Health and Safety Compliance Manager	1988–1995
	Gerald Garrett and Associates	Laboratory Manager/Field Technician	1987–1988
	Monical and Rea	Contract Chemist	1985–1987
CERTIFICATIONS AND MEMBERSHIPS	American Board of Industrial Hygiene—CIH Board of Certified Safety Professionals—CSP American Industrial Hygiene Association—Distinguished Fellow American Industrial Hygiene Association—past member Continuing Education Committee, member Environmental Issues Committee (past Executive Committee Member), member Law Committee (past Executive Committee Member), Project Lead, Vapor Intrusion Project Team (received Outstanding Volunteer Team award) American Society of Safety Engineers—member North Texas Section American Industrial Hygiene Association—member, Treasurer 2004–2009, Board of Directors 2010–2014 Southwest Section American Society of Safety Engineers – member American Society for Testing and Materials (ASTM) Vapor Intrusion Task Group—member State Bar of Texas—member State Bar of Virginia – member		

ROBERT L MILLER

PO BOX 100
SUMNER, TEXAS 75486
903-227-9954
BigDuk6@aol.com

MILITARY EOD EXPERIENCE	3.5 YEARS/USAF	UXO DATABASE NUMBER
COMMERCIAL UXO EXPERIENCE	21 YEARS	0276

CERTIFICATIONS / TRAINING

-US NAVAL EOD SCHOOL, PHASE I, EGLIN AFB, FL - 13 SEP 90
-US NAVAL EOD SCHOOL, PHASE II, INDIAN HEAD, MD - 06 FEB 91
-OSHA 40 HOUR HAZWOPER COURSE - 1995
-OSHA 8 HOUR HAZWOPER REFRESHER – 2020
-OSHA 8 HOUR HAZWOPER SUPERVISOR REFRESHER - 2008
-OSHA 10 HOUR CONSTRUCTION COURSE - 14 AUG 04
-OSHA 30 HOUR CONSTRUCTION SAFETY - 18 JUN 13
-NAVSEA MPPEH TRAINING - 23 MAR 15
-CPR AED - 2016
-JS-US007 LEVEL I ANTITERRORISM AWARENESS TRAINING - 01 JAN 19
-OPSEC AWARENESS - 05 MAY 2020
-USACE CQM - 2018

MILITARY EOD ASSIGNMENTS

02/91-02/94 EOD TEAM MEMBER - 2701 EODS, 649 CES / EODS - HILL AFB, UTAH.

CONDUCTED YEARLY CLEARANCES OF THE UTAH TEST AND TRAINING RANGE, DUGWAY PROVING GROUND AND WENDOVER RANGES. INVOLVED IN SUBSURFACE CLEARANCE AT EAKER AFB, AR. PROVIDED EOD SUPPORT TO THE 388TH TACTICAL FIGHTER WING, BASE SECURITY FORCE AND LOCAL LAW ENFORCEMENT.

UXO / COMMERCIAL CONTRACTS

08/2020-12/2020 UXOSO/QCS - EA ENGINEERING.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

07/2020-08/2020 SUXOS - EA ENGINEERING.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

05/2020-07/2020 UXOSO/QCS - EA ENGINEERING.

SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

02/2020 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

04/19-05/19 UXOSO/QCS - EA ENGINEERING.
SUBSURFACE CLEARANCE OPERATIONS.
YUMA PROVING GROUND, AZ.

02/19-03/19 UXOSO/QCS - EA ENGINEERING.
CONSTRUCTION SUPPORT AND DGM OPERATIONS.
YUMA PROVING GROUND, AZ.

09/18 UXOQCS - EA ENGINEERING.
SURVEY ESCORT OPERATIONS.
YUMA PROVING GROUND, AZ.

08/18-09-18 UXOQCS/QA - TLI SOLUTIONS.
THIRD PARTY QA / RANGE CLEARANCE OPERATIONS,
MCAS YUMA / CAMP BILLY MACHEN, NILAND, CA.

01/18-06/18 UXOQCA - TLI SOLUTIONS.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

12/17 UXOQCA - TLI SOLUTIONS.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

11/17-12/17 UXOQCS/QA - TLI SOLUTIONS.
THIRD PARTY QA / RANGE CLEARANCE OPERATIONS,
CAMP BILLY MACHEN, NILAND, CA.

10/17 UXOSO - TLI SOLUTIONS.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS,
PUEBLO CHEMICAL DEPOT, CO.

07/17-10/17 UXOQCA - TLI SOLUTIONS.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS.
PUEBLO CHEMICAL DEPOT, CO.

03/17-07/17 UXOSO - EA ENGINEERING.
SURFACE CLEARANCE OPERATIONS.
FORMER CAMP CLAIBORNE, LA.

09/16-03/17 UXOQCS - EA ENGINEERING.
SURFACE / SUBSURFACE CLEARANCE OPERATIONS.
YUMA PROVING GROUND, AZ.

07/16-08/16 SITE SUPERVISOR / SSHO / UXO TECH II - PLEXIS SCIENTIFIC. EQUIPMENT OPERATION AND UXO AVOIDANCE, HAZMAT EXCAVATION OPERATIONS, FORT MONROE, HAMPTON, VA.

05/16 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

03/16-04/16 UXO TECH III - STERLING GLOBAL OPERATIONS. CONSTRUCTION SUPPORT OPERATIONS, R.S. PARKER PROPERTY, MYRTLE BEACH, SC.

10/15 UXOSO/QCS - STERLING GLOBAL OPERATIONS. SURFACE CLEARANCE OPERATIONS AND ENVIRONMENTAL SAMPLING, PACIFIC SPACEPORT COMPLEX ALASKA, KODIAK, AK.

06/15-07/15 UXO TECH III - STERLING GLOBAL OPERATIONS. SUBSURFACE CLEARANCE, FORT McCLELLAN, ANNISTON, ALABAMA.

05/15 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

03/15-04/15 UXOSO/QCS - AECOM. NON TIME CRITICAL REMOVAL ACTION, BASE STORMWATER OUTFALL DITCH, KINGSVILLE NAVAL AIR STATION, KINGSVILLE, TEXAS.

03/15 ADJUNCT INSTRUCTOR - TEEX. AORLE COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

09/14-10/14 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

07/14-08/14 ADJUNCT INSTRUCTOR - TEEX. AORLE COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

04/14 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I AND DEMINING COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

01/14-03/14 UXO TECH III - STERLING GLOBAL OPERATIONS. SUBSURFACE CLEARANCE, FORT McCLELLAN, ANNISTON, ALABAMA.

10/13-11/13 UXO TECH III - STERLING GLOBAL OPERATIONS. SUBSURFACE CLEARANCE, FORT McCLELLAN, ANNISTON, ALABAMA.

09/13 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

07/13-08/13 UXO TECH III - STERLING GLOBAL OPERATIONS. SUBSURFACE CLEARANCE, FORT McCLELLAN, ANNISTON, ALABAMA.

09/12-06/13 UXO TECH III - EOD TECHNOLOGY / SGO. CONSTRUCTION SUPPORT OPERATIONS, FORT HUNTER LIGGET, CALIFORNIA.

05/12-06/12 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

03/12-04/12 UXO TECH III - PLEXUS SCIENTIFIC CORPORATION.SUBSURFACE CLEARANCE / DEMO OPERATIONS, FORMER CAMP HOWZE, GAINESVILLE, TEXAS.

02/12 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

11/11-12/11 UXO TECH III - EOD TECHNOLOGY, INC. SURFACE CLEARANCE / DEMO OPERATIONS, FORT HUNTER LIGGET, CALIFORNIA.

10/11 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

09/11 UXO TECH III - HGL. SUBSURFACE CLEARANCE, FORT CARSON, COLORADO.

07/11-8/11 UXO TECH III - PIKA/AEROTEK. DECON/DEMIL OPERATIONS, LAKE CITY ARMY AMMUNITION PLANT, INDEPENDENCE, MO.

04/11-7/11 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

02/11 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

01/11 UXO TECH III - EOD TECHNOLOGY, INC. RI/FS, CAMP CLAIBORNE, ALEXANDRIA, LA.

04/10-11/10 UXO TECH III - EOD TECHNOLOGY, INC. SUBSURFACE CLEARANCE, GOODSON TRACT 19, MYRTLE BEACH, SOUTH CAROLINA.

04/10 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

08/09-03/10 UXO TECH III - EOD TECHNOLOGY, INC. UXO CONSTRUCTION SUPPORT OPERATIONS. CAMP BULLIS, TEXAS.

06/09-07/09 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS

03/09-05/09 UXO TECH III - EOD TECHNOLOGY, INC. SUBSURFACE CLEARANCE, CAMP BULLIS, TEXAS. CONSTRUCTION SUPPORT OPERATIONS, FORT SAM HOUSTON, TEXAS.

02/09 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

12/08 UXO TECH III - EMERALD STATE ENVIRONMENTAL. SUBSURFACE CLEARANCE, FORT BRAGG, NORTH CAROLINA

11/08 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

06/08-10/08 SUXOS - ZAPATA INCORPORATED. RI/FS, FORMER CAMP GRUBER MILITARY RESERVATION, CWMA, ZEB, OKLAHOMA.

05/08 UXO TECH II - ZAPATA INCORPORATED. MEC INVESTIGATION, CAMP LEJEUNE, NORTH CAROLINA.

04/08-05/08 UXOSO/QCS/TECH III - ZAPATA INCORPORATED. RI/FS SOUTHWEST PROVING GROUND, HOPE, ARKANSAS.

02/08-03/08 UXO TECH II - ZAPATA ENGINEERING. UXO RECON, CAMP GRUBER, OKLAHOMA

09/07-12/07 UXO INSTRUCTOR - TEXAS ENGINEERING EXTENSION SERVICE. UXO TECH I COURSE INSTRUCTION, TEXAS A&M UNIVERSITY, RIVERSIDE CAMPUS, BRYAN, TEXAS.

08/07-09/07 SUXOS - ZAPATA ENGINEERING. SUBSURFACE CLEARANCE, MPMG CAMP SWIFT, TEXAS.

07/07 UXO TECH III - JACOBS ENVIRONMENTAL. UXO SUPPORT/AVOIDANCE, TANAGA ISLAND, ALASKA.

04/07-05/07 UXO TECH III - ZAPATA ENGINEERING. SUBSURFACE CLEARANCE, ARAPAHOE PARK, COLORADO.

10/06-02/07 UXO TECH III / DEMOLITION SUPERVISER - ZAPATA ENGINEERING. RANGE COMPLEX CLEARANCE, FORT HOOD, TEXAS.

09/06 UXO TECH III - SHAW ENVIRONMENTAL & INFRASTRUCTURE, INC. SURFACE / SUBSURFACE CLEARANCE, ISLETA / PUELBO RESERVATION, ALBUQUERQUE, NEW MEXICO.

06/06- 08/06 UXO TECH III - EARTH TECH. EOD DEMO RANGE CLEARANCE, CARSWELL AFB, TEXAS.

02/06-05/06 UXO TECH III - SHAW ENVIRONMENTAL & INFRASTRUCTURE, INC. SUBSURFACE CLEARANCE, FORT HOOD, TEXAS.

11/05-12/05 UXO TECH III - SHAW ENVIRONMENTAL & INFRASTRUCTURE, INC. SURFACE CLEARANCE, FORT HOOD, TEXAS.

04/05-09/05 UXO TECH III / SSHO - AMERICAN TECHNOLOGIES, INC. SUBSURFACE CLEARANCE, FORMER FIVE POINTS BOMBING RANGE, ARLINGTON, TEXAS.

10/04-01/05 UXO TECH III - EOD TECHNOLOGY, INC. RANGE COMPLEX CLEARANCE. FORT HOOD, TEXAS.

08/04-09/04 UXOSO/QCS - AMERICAN TECHNOLOGIES, INC. SUBSURFACE CLEARANCE, ROGERS-PEEBLES PROPERTY, JESUP, GA.

5/04-08/04 UXO TECH III - EOD TECHNOLOGY, INC. RANGE COMPLEX CLEARANCE OPERATIONS, FORT HOOD, TEXAS.

09/03-04/04 EOD TEAM LEADER / TECHNICIAN III - USA ENVIRONMENTAL, INC. IRAQI SURVEY GROUP SUPPORT / EOD OPERATIONS, BAGHDAD, IRAQ.

08/03-09/03 UXO TECH II - EOD TECHNOLOGY, INC. RANGE/TARGET RESIDUE INSPECTION AND DISPOSAL. FORT POLK, LA.

02/03-07/03 UXO TECH II - EOD TECHNOLOGY, INC. SITE CHARACTERIZATION AND INTRUSIVE OPERATIONS, CAMP CLAIBORNE, LA.

12/02-02/03 UXO TECH II - SCI UXO / OE SERVICES. UXO DOWNHOLE MONITORING / AVOIDANCE, CAMP BULLIS, TX.

11/02 UXO TECH II - SCI UXO / OE SERVICES. SURFACE CLEARANCE, RIGGS ANTI-ARMOR RANGE, FORT HOOD, TX.

08/02-11/02 UXO TECH II - EHSI. SURFACE / SUBSURFACE CLEARANCE AND CONSTRUCTION SUPPORT, FORT HOOD, TX.

08/02 UXO TECH III - EOD TECHNOLOGY, INC. OE RESIDUE INSPECTION AND REMOVAL LAKEHURST NAVAIR DRMO, NJ.

03/02-08/02 UXO TECH III - EOD TECHNOLOGY, INC. UNSERVICEABLE NITROCELLULOSE REMOVAL AND REPACKAGING, CAMDEN, AR.

10/01 UXO TECH II - SCI UXO / OE SERVICES. UXO SURFACE CLEARANCE, CAMP BULLIS, TX.

01/02 UXO TECH II - USA ENVIORNMENTAL, INC. UXO SUPPORT, LACKLAND AFB, TX.

12/01 UXO TECH II - USA ENVIORNMENTAL, INC. CONSTRUCTION SUPPORT / SUBSURFACE ANOMOLY INVESTIGATION AND DISPOSITION, FORT BENNING, GA.

10/01-11/01 UXO TECH II - ENVIORNMENTAL CHEMICAL CORPORATION. UXO SURVEY / AVOIDANCE, DUGWAY PROVING GROUND, UT.

08/01 UXO TECH II - ENVIORNMENTAL CHEMICAL CORPORATION. UXO / EXCAVATION SUPPORT, DUGWAY PROVING GROUND, UT.

07/01-08/01 UXO TECH II / DIVER - ENVIORNMENTAL CHEMICAL CORPORATION. UNDERWATER CLEARANCE / OE REMOVAL, PACKAGING AND DISPOSITION, NAS JRB, NEW ORLEANS, LA.

05/01-06/01 UXO TECH II - EOD TECHNOLOGY, INC. SUBSURFACE CLEARANCE, FORT CAMPBELL, KY

01/01-05/01 UXO TECH II - ENVIORNMENTAL CHEMICAL CORPORATION. UXO/OE CLEARANCE AND REMOVAL, NAS JRB, NEW ORLEANS, LA.

07/00-11/00 UXO SPECIALIST - UXB INTERNATIONAL, INC. SUBSURFACE CLEARANCE, CAMP MAXEY, TX.

06/00-07/00 UXO SPECIALIST - SUDHAKAR COMPANY, INC. SUBSURFACE CLEARANCE, CRAB ORCHARD, IL.

03/00 UXO SPECIALIST - UXB INTERNATIONAL, INC. GRID SAMPLING / SUBSURFACE CLEARANCE, CAMP CROFT, SC.

04/99-03/00 EOD TECHNICIAN / SYSTEM OPERATOR - TEAM TELEDYNE / UXB. NON-STOCKPILE SYSTEMS PROGRAM, MUNITION MANAGEMENT DEVICE (MMD-1), SMALL BURIALS CHEMICAL DEMILITARIZATION PROGRAM, SYSTEM TESTING AND DEVELOPMENT, DUGWAY PROVING GROUND, UT.

11/98-03/99 UXO SPECIALIST - EOD TECHNOLOGY, INC. SUBSURFACE CLEARANCE, CAMP CLAIBORNE, LA.

06/98-10/98 UXO SPECIALIST - UXB INTERNATIONAL, INC. GRID SAMPLING AND UXO INVESTIGATION, CAMP HOWZE, TX.

11/97-05/98 UXO SPECIALIST - EOD TECHNOLOGY, INC. SUBSURFACE CLEARANCE, CAMP CLAIBORNE, LA.

05/97-10/97 UXO SPECIALIST - UXB INTERNATIONAL, INC. GRID STAT SAMPLING AND UXO INVESTIGATION, BUCKLEY BOMBING RANGE, CO.

04/97-05/97 UXO SPECIALIST - CMS ENVIORNMENTAL, INC. OEW REMOVAL / SUBSURFACE CLEARANCE, FORT WINGATE, NM.

02/97-03/97 UXO SPECIALIST - HFA, INC. SURFACE / SUBSURFACE CLEARANCE, CAMP MAXEY, TX.

07/96-11/96 DEMINING TECHNICIAN - UXB INTERNATIONAL, INC. DEMINING AND REMOVAL OF LAND MINE, BOOBYTRAP AND UXO HAZARDS FOR USAID AND PARSONS, BOSNIA-HERZEGOVINA.

05/96-07/96 UXO SPECIALIST - CMS ENVIORNMENTAL, INC. EXPLOSIVES REMOVAL AND PACKAGING, OEW DECONTAMINATION AND DISPOSAL, OLIN / WINCHESTER PLANT, ALTON, IL.

01/96-03/96 UXO SPECIALIST - UXB INTERNATIONAL, INC. SURFACE / SUBSURFACE CLEARANCE, CAMP STANLEY, TX.

09/95-12/95 UXO SUPERVISOR - UXB INTERNATIONAL, INC. UXO ESCORT / CLEARANCE, KAHO'OLAWE ISLAND, HI.

09/95 UXO SPECIALIST - UXB INTERNATIONAL, INC. SITE TESTING, LONGHORN ARMY AMMUNITION PLANT, TX.

06/95-09/95 UXO SPECIALIST - UXB INTERNATIONAL, INC. SUBSURFACE CLEARANCE, CAMP CLAIBORNE, LA.

05/95-06/95 UXO SPECIALIST - UXB INTERNATIONAL, INC. SURFACE / SUBSURFACE CLEARANCE, FORT WINGATE, NM.

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ATTACHMENT 2

SITE SAFETY AND HEALTH PLAN

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ATTACHMENT 2

SITE SAFETY AND HEALTH PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Delivery Order No. W912BV20F0207

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SITE SAFETY AND HEALTH PLAN APPROVAL

This Site Safety and Health Plan (SSHP) was prepared for employees performing a specific, limited scope of work. It was prepared based on the best-available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of this project, adherence to the requirements of the SSHP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve the SSHP for the Longhorn Army Ammunition Plant (LHAAP) site. This SSHP has been written for the exclusive use of Munitions Management Group, LLC (MMG)-TLI Solutions, Inc. (TLI) Joint Venture (MMG-TLI JV), its employees, and subcontractors. The plan is written for specified site conditions, dates, and personnel and must be amended if these conditions change.

Owens P. Carter

8/24/2021

Plan Prepared by: Owens Carter, SMS
Safety Specialist, MMG-TLI JV
Phone: (865) 919-4862

Date

8/24/2021

Plan Approval by: Don Jenkins
Program Manager, MMG-TLI JV
Phone: (303) 403-4056

Date

Erika Erikson

8/25/2021

Plan Approval by: Erika Erikson, CIH, CSP
Corporate Health and Safety Manager, MMG-TLI JV
Phone: (571) 386-7304

Date

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List of Acronyms

AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
BIP	blown in place
bpm	beats per minute
˚C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CO	Contracting Officer
COR	Contracting Officer’s Representative
CP	competent person
CPR	cardiopulmonary resuscitation
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
DA	Department of the Army
dBA	decibels
DCA	Dichloroethane
DCE	1,1-Dichloroethene
DD	Decision Document
DESR	Defense Explosives Safety Regulations
DFW	definable feature of work
DGM	digital geophysical mapping
DoD	United States Department of Defense
DTL	Demolition Team Lead
EAP	Emergency Action Plan
EC	Emergency Coordinator
EM	Engineering Manual
EMM	earth moving machinery
EMO	Environmental Management Office
EOD	Explosive Ordnance Disposal
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
ESP	Explosives Site Plan
ETLV	exposure threshold limit values
°F	degrees Fahrenheit
FDRF	Fragmentation Data Review Form
FS	Feasibility Study
ft	foot
GFCI	ground-fault circuit-interrupter
GPS	Global Positioning System

HAZWOPER	Hazardous Waste Operations and Emergency Response
HSD	Health and Safety Director
IAW	in accordance with
LEL	lower explosive limit
LTM	long-term monitoring
LUC	land-use control
m	meter
mm	millimeter
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MEK	methyl ethyl ketone
MIBK	4-Methyl-2-pentanone
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC-TLI Solutions, Inc. Joint Venture
MMRP	Military Munitions Response Program
MNA	monitored natural attenuation
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MPPEH	Material Potentially Presenting an Explosive Hazard
MR	Munitions Response
MRS	Munitions Response Site
MSD	minimum separation distance
MTL	Munitions and Explosives of Concern Technical Lead
NEC	National Electric Code
NESC	National Electric Safety Code
NFA	No Further Action
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
NWS	National Weather Service
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
PAM	Department of the Army Pamphlet
PCA	1,1,1,2-Tetrachloroethane
PCE	1,1,1,2-Tetrachloroethane
PCD	Pueblo Chemical Depot
PEL	permissible exposure limit
PM	Project Manager
PMP	Project Management Professional
PPE	personal protective equipment
PWS	Performance Work Statement
RAC	Risk Assessment Code
RAMR	Remedial Action Monitoring Report

RCWM	recovered chemical warfare material
RDW	remediation-derived waste
RDX	cyclotrimethylenetrinitramine
RDW	remediation-derived waste
REL	recommended exposure limit
RI	Remedial Investigation
RM	Response Manager
ROD	Record of Decision
SDS	Safety Data Sheet
SHM	Safety and Health Manager
SI	Site Investigation
SOP	Standard Operating Procedure
SPF	solar protection factor
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SSR	Subcontractor’s Safety Representative
STEL	short-term exposure limit
SUXOS	Senior Unexploded Ordnance Supervisor
TCA	1,1,1-Trichloroethane
TCE	trichloroethene
TechLaw	TechLaw Consultants, Inc.
Tetryl	2,4,6-trinitrophenylmethylnitramine
TL	Team Lead
TLI	TLI Solutions, Inc.
TM	Task Manager
TNT	2,4,6-trinitrotoluene
TWA	time-weighted average
UEL	upper explosive limit
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
UTV	utility task vehicle
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
UXOT	Unexploded Ordnance Technician
UXOT III	Unexploded Ordnance Technician III
UV	ultraviolet
WBGT	wet-bulb globe temperature

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1.0 INTRODUCTION

General information including site background, responsibilities and lines of authority, general site control, and general site safety standards are presented in the Accident Prevention Plan (APP).

The provisions of this plan are mandatory for all on-site employees engaged in hazardous material management activities associated with this project that may involve health and safety hazards. Munitions Management Group, LLC (MMG)-TLI Solutions, Inc. (TLI) Joint Venture (MMG-TLI JV) is providing a copy of this plan to each site subcontractor to fulfill its obligation under 29 Code of Federal Regulations (CFR) 1910.120(b) to inform subcontractors of site hazards. Each subcontractor is to provide a safety plan that complies with 29 CFR 1910.120 and Engineering Manual (EM) 385-1-1, which addresses the activities of its employees relevant to this project.

All employees and subcontractors of MMG-TLI JV involved in this project are required to abide by the provisions of this SSHP. They are required to read this plan and sign the Personnel Acknowledgement form included in Section 11.0 prior to commencement of work activities. A copy of this SSHP, APP, and the TechLaw Consultants, Inc. (TechLaw) Corporate Health and Safety Program Document shall be maintained on-site and available for review at all times. The TechLaw Health and Safety Program has been adopted by MMG-TLI JV.

All personnel conducting field activities associated with this project are required to have 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and current annual 8-Hour HAZWOPER refresher training. An assigned and qualified Site Safety and Health Officer (SSHO) will be on-site at all times. The unexploded ordnance (UXO) safety officer (UXOSO) will be the on-site SSHO. The SSHO/UXOSO and all personnel in a supervisory position will be trained as a HAZWOPER Site Supervisor in accordance with (IAW) 29 CFR 1910.120 (e)(4).

The H&S guidelines and requirements presented are based on a review of available information and an evaluation of potential hazards. This SSHP outlines the health and safety procedures and equipment required for activities performed at LHAAP.

1.1 Policy Statement

It is the policy of MMG-TLI JV to provide a safe and healthy work environment for all of its employees. MMG-TLI JV considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts. Every accident and every injury is avoidable. MMG-TLI JV will take every reasonable step to reduce the possibility of injury, illness, or accident. This policy is detailed in the TechLaw Corporate Health and Safety Plan.

The practices and procedures presented in this SSHP and any supplemental documents associated with this SSHP are binding on all MMG-TLI JV employees while engaged in the subject work. In addition, all site visitors shall abide by these procedures as the minimum acceptable standard for the work site. Operational changes to this SSHP and supplements that could affect the health or safety of personnel, the community, or the environment will not be made without prior approval of the MMG-TLI JV Munitions and Explosives of Concern (MEC) Technical Lead (MTL), Project Manager (PM) and the Corporate Health and Safety Director (HSD). In the event of a conflict between this SSHP, Federal, State, and local regulations, workers shall follow the most stringent/protective requirements. The MMG TLI JV Team will comply with State of Texas, U. S. Army, and LHAAP COVID-19 mandates and requirements.

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2.0 SITE INFORMATION AND SCOPE OF WORK

MMG-TLI JV will conduct environmental services at LHAAP IAW the Performance Work Statement (PWS) developed for LHAAP. The following is a summary of relevant data concerning the LHAAP sites and MMG-TLI JV's PWS.

2.1 Project Information

LHAAP is a former, government-owned, contractor-operated and maintained DoD facility located in central-east Texas in the northeastern corner of Harrison County. The footprint of the former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

Various media in certain areas have been contaminated by past industrial operations and waste management practices at LHAAP. Industrial operations involved the use of secondary explosives, rocket motor propellants, and various pyrotechnics, such as illuminating and signal flares and ammunition. Explosives included 2,4,6-trinitrotoluene (TNT) and black powder. Typical composite propellants were composed of a rubber binder, an oxidizer such as ammonium perchlorate, and a powdered metal fuel such as aluminum. Pyrotechnics were generally composed of an inorganic oxidizer such as sodium nitrate, a metal powder such as magnesium, and a binder. Other materials used in the industrial operations included acids, lubricants, and solvents; particularly trichloroethene (TCE) and methylene chloride. Waste management included sanitary wastewater treatment, industrial wastewater treatment, holding/evaporation ponds, storm water drainage, sanitary and industrial waste landfills, and demolition/burning grounds. Discharges and releases to surface water, groundwater, and other secondary media have occurred from the historical operations.

LHAAP was placed on the National Priorities List on August 9, 1990. A Federal Facility Agreement (FFA), among the U.S. Army, the USEPA, and the Texas Natural Resources Conservation Commission (now the TCEQ), became effective on December 30, 1991, to address the contamination at LHAAP. The environmental cleanup actions at LHAAP are carried out under CERCLA, with the U.S. Army as the lead agency, in coordination with the USEPA, and the TCEQ, in conformance with the FFA. A dispute arose in October 2011 regarding four sites in the TO: LHAAP-16, LHAAP-17, LHAAP-001-R-001, and LHAAP-003-R-001. Dispute resolution per the FFA was resolved as documented in the USEPA's October 2014 dispute resolution letter for these four sites.

LHAAP became inactive and excess to the Army's needs in July 1997. Between 1998 and 2000, the Government liquidated all personal property and specific installed property. In 1999, the Army demolished several structurally unsafe buildings. The United States Fish and Wildlife Service (USFWS) requested all of LHAAP during the federal screening for Government property disposal. The Base Realignment and Closure (BRAC) Division received administrative control of LHAAP in October 2002. A Memorandum of Agreement between the Army and USFWS was signed in April 2004 (U.S. Army 2004) providing the terms and conditions of property transfer at LHAAP. Approximately 7,100 of the 8,416-acre installation have been transferred to USFWS. Army Environmental Command (AEC) is responsible for funding the Installation Restoration Program (IRP) and MMRP Programs at LHAAP. The BRAC Division holds responsibility for administrative control and transfer of property of LHAAP.

The LHAAP Information Repository is maintained at the Government Trailer on LHAAP. The LHAAP Administrative Record (AR) is maintained at the Government Trailer (hard copy and electronic) and at the Marshall Public Library (electronic only).

Additional information is available on the LHAAP Environmental Restoration Program Website: http://www.longhornaap.com/.

2.1.1 Site-Specific Information

2.1.1.1 Site LHAAP-17

The remediation activities required for Site LHAAP-17 are presented in an approved Final Remedial Design/Remedial Action Work Plan (RD/RAWP) prepared by Bhate Environmental Associates, Inc. (Bhate) in 2019. Bhate initiated soil remediation at Site LHAAP-17 based on this RD/RAWP but was unable to finish due to encountering the presence of munitions and explosives of concern (MEC). The MEC that Bhate encountered is comprised of two 81-millimeter (mm) Mortar M301, illuminating, nine-artillery base tracer elements, and one-M19 series rifle-launched green parachute signal.

This site was used for burning bulk TNT, photoflash powder, and reject material from Universal Match Corporation’s production processes. The site was operated as a burning ground from 1959 until 1980 and consisted of four burning pits 5 feet deep and 10 feet wide (U.S. Army Environmental Hygiene Agency [USAEHA], 1987). TNT has been detected in surface soils.

Waste residues were removed in 1984 with evidence of bulk burial of TNT occurring prior to 1954 and the area was grassed over. Volatile organic compounds (VOCs) and explosive compounds were found in the groundwater. Explosive compounds were found in the soil. Perchlorate was detected in groundwater and soil at this site in 2000. A Remedial Investigation (RI) was completed in 2002 and a Feasibility Study (FS) was finalized in 2010. A Research and Development project for enhanced in-situ bioremediation (perchlorate in soil) was started in 2002 and completed in 2004 by Planteco Environmental Consultants. The Final Record of Decision (ROD) was signed in September 2016 identifying the remedy as excavation of contaminated soil, extraction and treatment of groundwater, monitored natural attenuation (MNA) and land use controls (LUCs). A Pre-Design Investigation (PDI) Work Plan was finalized in November 2016 for resampling existing wells, installation of up to three new monitoring wells, additional soil sampling to refine extent of soil contamination, and conducting a shallow zone pumping test and results reported in the Draft Final PDI Report approved in September 2018. The Draft Final RD/RAWP was approved in March 2019.

Excavation activities began at Site LHAAP-17 in August 2019 with a goal to remove soil contaminated with TNT, 2,4-dinitrotoluene (DNT), 2,6-DNT and perchlorate at levels exceeding human health criteria and transport the contaminated soil to a suitable landfill. On August 30, 2019, halfway through excavation work, the Contractor uncovered a 4.2” mortar in Area M. Based on the history of the site, munitions were not expected to be found at Site LHAAP-17, and as a result, their hazards and disposal were not addressed in the excavation contract/task order. As a result, work was temporarily stopped while military Explosive Ordnance Disposal (EOD) responded. EOD personnel identified the ordnance as an unfuzed 4.2” illumination mortar which appeared to be empty. However, the space inside the projectile could not be fully cleared of dirt, ash, and other debris to determine if all of the expelling charge had been consumed during past disposal attempts. EOD moved the round to a 2-foot deep trench opened by excavation activities and detonated a countercharge to clear the round. Based on the results of the shot, the EOD team determined that the mortar was empty. Based on EOD findings, it was believed that this was an anomaly for the site, and subsequently the Contractor was directed to continue work. On September 7, 2019, a second 4.2” mortar was unearthed by the excavator in Area N resulting in another work stoppage. EOD again responded to the site, and on examination, found that this second mortar projectile was completely empty. They removed it from the site. Excavation work resumed on Monday September 16, 2019, with an USACE Ordnance and Explosives Safety Specialist (OESS) on site to provide support in case further munitions were disclosed during soil removal. The OESS located and identified hundreds of munitions items within the excavation areas, and was able to determine their condition without stopping work; however, he did locate material potentially presenting an explosive hazard (MPPEH) which generated two more EOD responses. On Friday September 27, 2019, EOD was called out to dispose of two M301 81-mm illuminating mortars that the USACE OESS removed from areas M and N, but he could not ascertain their explosive safety status due to a metal baffle closing the body cavity behind the fuze wells. EOD performed field radiography on both mortars, and disposed of them by detonation in the open excavation in Area L. Based on their analysis, EOD reported that the two 81-mm mortars contained live flares. On Saturday September 28, 2019, the USACE OESS found one live M19 series rifle-launched green parachute signal mixed in with debris from 134 other signals and flares found in the soil stockpile excavated from Area H, and nine live artillery base tracer elements discovered in an accumulation of 124 tracer elements found in a soil stockpile set aside for transportation adjacent to Area K. As a result of these accumulated finds, all work was stopped at the site. All of this MEC was destroyed in a detonation on-site by EOD on September 30, 2019. The Contractor was directed by the Contracting Officer (KO) to stop work and no additional intrusive activity will be conducted at Site LHAAP-17 under the Bhate contract/task order.

Project Description:

MMG-TLI JV is responsible for executing environmental activities required to comply with the selected remedies under the existing ROD for the facility and additional activities under the MMRP, as detailed below. MMG-TLI JV and it sub-contractors (Bhate, AECOM, and Robotics Fabrication, Inc. [RFI]) are responsible for furnishing all labor, materials, and equipment necessary to meet the performance objectives and standards identified in the PWS.

MMG-TLI JV is responsible for the full range of performance-based investigation and environmental remediation activities to achieve performance objectives for supporting progress toward Site Closeout or Response Complete, as applicable, for Site LHAAP-17.

The primary objectives are:

- Determine the extent of MEC/MPPEH;
- Confirm the presence or absence of munitions in the surface or subsurface;
- Complete an instrument-assisted surface clearance to remove all MEC and MPPEH and other metallic debris of a size (interpreted for this site as metallic debris 1.5 inches x 3 inches or larger) that may impact the quality of the digital geophysical mapping (DGM) data;
- Remove vegetation that would interfere with DGM, if any;
- Conduct geophysical transect surveys across the area;
- Analyze the geophysical data to identify individual target anomalies for intrusive removal;
- Reacquire, remove, and inspect the selected target anomalies;
- Properly manage and dispose of MEC and MPPEH, if any, and any remediation-derived waste (RDW) streams;
- Complete munitions constituents (MC) sampling of soil beneath MEC that is acceptable to move and following MEC demolition;
- Install the groundwater extraction system components; and,
- Restore the site.

2.2 Scope of Work

2.2.1 MMRP Work Activities

A surface clearance and subsequent DGM of the LHAAP-17 Site will be performed to complete the project objective. The following work phases may be used to accomplish tasks at the LHAAP:

- Mobilization/Demobilization
- Transect delineation

- Installation of an instrument test strip (ITS) and blind seeding
- Decontamination
- RDW Management
- Vegetation removal, if necessary
- Surface clearance
- Geophysical surveys
- Intrusive removal/inspection activities (“mag and dig”)
- MC Sampling
- MEC Disposal Operations
- MPPEH processing and material documented as safe (MDAS) disposition
- Installation of groundwater extraction system components
- Site restoration and demobilization

An Activity Hazard Analysis (AHA) for each task is included in Tab A of this document.

2.2.1.1 Site Preparation

A surface clearance is planned for the LHAAP-17 Site. All MEC/MPPEH and any munitions debris (MD) (greater in size than a 20-mm projectile body [0.75-inches x 2.5-inches]) will be demilitarized and properly disposed of.

2.2.1.2 Transect-Based Digital Geophysical Mapping

Prior to performance of DGM, all vegetation and brush that would interfere with the DGM will be cut/removed. Due to the size of the project area, mechanical vegetation/brush removal means will likely be utilized. Cut vegetation may be left on-site in a manner that does not pose a safety hazard.

2.2.1.3 Reacquisition and Intrusive Removal of Anomalies

DGM will be completed over all the accessible areas of LHAAP-17 Site using virtual grids at a 0.5-meter (m) line spacing.

2.2.1.4 Material Potentially Presenting an Explosive Hazard/Munitions and Explosives of Concern Handling, Certification, and Disposal

If a recovered surface item is considered MPPEH/MEC, a positive identification of the item will be obtained. Any MPPEH that cannot be verified to be free of explosive hazards or is suspected to present an explosive hazard will be classified as MEC. If the item is identified as MEC, a determination will subsequently be made as to whether or not it is fuzed. MPPEH that is suspected of presenting an explosive hazard will be considered MEC. Any MEC encountered will be clearly marked, and its position will be recorded by Global Positioning System (GPS) or other accurate means. Data regarding type, size, condition, location, etc., of MEC located during the munitions response will be recorded, and all MEC encountered will be photographed to allow subsequent verification of the identification by the UXO Quality Control Specialist (UXOQCS). The UXO Technician (UXOT) III (UXOT III)/Team Lead (TL) will evaluate the item(s) found and immediately report the condition of the item(s) to the Senior UXO Supervisor (SUXOS) and UXOSO. No MPPEH/MEC will be moved without first being evaluated by the SUXOS and the UXOSO, resulting in a positive identification of the item(s) and an evaluation of its condition.

MEC items deemed acceptable to move may, IAW the approved Explosives Site Plan (ESP), be moved for consolidation with other items to reduce the number of demolition shots required. However, MEC/MPPEH deemed acceptable to move will not be moved outside of the site boundary. A separate determination on disposal will be made by the SUXOS and UXOSO for each occurrence. No MEC identified for destruction will be removed outside the site boundary. MEC items not deemed acceptable to move will be blown in place (BIP). If a MEC item cannot be safely BIP under the existing conditions, the Task Manager (TM) will be notified, and a determination will be made how to resolve the situation safely.

Safe and proper handling of propellant grains and other bulk high explosives, if they are encountered on this site, are discussed in Tab A, *AHA-9 MPPEH Processing.*

Disposal of MEC/MPPEH will follow the procedures outlined in the approved UFP-QAPP and site ESP. During disposal of MEC and related material, safety will be the primary concern. The primary requirements are to protect personnel, the public, and the environment from fire, blast, noise, fragmentation, and toxic releases. Planned detonation of explosives will be conducted IAW the requirements outlined in United States Department of Defense (DoD) 6055.9-M and the applicable Fragmentation Data Review Form (FDRF). If an item is encountered that doesn’t have a FDRF, it will be handled by utilizing the Generic Equations Calculator to determine the minimum separation distances (MSDs). Disposal operations will be under the direct control of the demolition team lead (DTL), who will be an experienced and trained UXOT III charged with the responsibility for all demolition activities at the site.

2.2.1.5 Materials Potentially Presenting an Explosive Hazard Processing

The following additional tasks will also be performed as necessary in support of planned site activities:

- <u>Mobilization/Demobilization</u>: Mobilization and demobilization represent limited pre- and post-task activities. These activities include driving to and from the site; initial site preparations, such as office facilities setup; equipment receipt, explosives magazine siting, and post-work activities, such as removal of files and office equipment; shipment of equipment and magazines; final disposition of MDAS; and general housekeeping.

2.2.1.6 Remediation-Derived Waste Management

RDW (e.g., soil cuttings, purge water, disposable personal protective equipment [PPE], decontamination fluids, and trash) will be collected and containerized, staged, and managed according to a waste determination based on its source of generation and, where applicable, analytical results.

2.2.1.7 Soil Sampling

Soil samples will be collected to evaluate residual MC based on field MC findings when: (1) MEC is identified and safely moved, and, (2) where BIP or consolidated shots take place.

2.2.1.8 Equipment Decontamination

Reusable sampling equipment will be decontaminated between locations.

2.2.1.9 Installation of groundwater extraction system components

Extraction pumps will be installed in wells. Extraction piping will be installed at each well and connected to a manifold and holding tank. The discharge pipe from the holding tank will feed into the Groundwater Treatment Plant. Backflow preventers will be installed as needed to prevent cross flow to or from LHAAP-16.

2.2.1.10 Site Restoration

Site restoration activities will include backfilling of digs and re-seeding.

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3.0 PROJECT HEALTH AND SAFETY ORGANIZATION

MMG-TLI JV will have site safety and health oversight and coordination responsibilities for all personnel; each subcontractor will be held accountable for the safe and healthful performance of work by each of their employees, subcontractors, or support personnel who may enter the site.

The health and safety organization for this project is as follows:

- Program Manager – Don Jenkins
- Project Manager – Kyra Donnell
- Health and Safety Manager – Erika Erikson, Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP)
- MEC Technical Lead – Brian Gentry
- SUXOS – Ray Fillion
- UXOSO – Robert L. Miller

The responsibilities, authority, and qualifications for each person are detailed in Section 4 of the APP.

3.1 Project Personnel

3.1.1 Personnel Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the SSHP and other applicable safety policies and asking for clarification for those areas where understanding is incomplete;
- Providing feedback to health and safety management relating to omissions and modifications in the SSHP or other safety policies; and
- Notifying the UXOSO of unsafe conditions and acts.

3.1.2 Personnel Authority

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work when the employee feels that the work is unsafe (including subcontractors or team contractors) or where specified safety precautions are not adequate or fully understood;
- The right to refuse to work on any site or operation where the safety procedures specified in this SSHP or other safety policies are not being followed; and
- The right to contact the UXOSO or the HSD at any time to discuss potential concerns.

3.2 Subcontractors

MMG-TLI JV will provide a copy of the APP and SSHP to each subcontractor to fulfill its obligation under 29 CFR 1910.120(b) to inform subcontractors of site hazards. Each subcontractor will provide their own AHAs that complies with 29 CFR 1910.120 and addresses the activities of its employees relative to this project. In addition, each subcontractor will provide training certification proof for 40-Hour HAZWOPER and 8-Hour HAZWOPER refresher training for personnel involved with field activities.

Each subcontractor is requested to designate a Subcontractor's Safety Representative (SSR), who is the subcontractor supervisor. The SSR is responsible for the safe and healthful performance of work by his/her work force and subcontractors. During subcontractor activities on-site, the SSR will perform continuing work area inspections and conduct safety meetings and safety orientations for all new employees. The SSR will attend periodic safety meetings with the UXOSO. The SSR will also investigate accidents and overexposures involving subcontractor personnel.

3.3 Visitors

Authorized visitors (e.g., client representatives, regulators, MMG-TLI JV management staff, etc.) requiring entry to any work location on the site will be briefed by the UXOSO on the hazards present at that location. Visitors will be escorted at all times (by a UXO-qualified person for MMRP activities) at the work location and will be responsible for compliance with their employer’s health and safety policies. In addition, this SSHP specifies the minimum acceptable qualifications, training, and PPE, which are required for entry to any controlled work area; visitors must comply with these requirements.

Unauthorized visitors and visitors not meeting the specified qualifications will not be permitted within established controlled work areas.

4.0 SAFETY PROGRAMS

4.1 Hazardous Waste Operations and Emergency Response Qualifications

Personnel performing work at the job site must be qualified as HAZWOPER workers (unless otherwise noted in a specific AHA or by the UXOSO) and must meet the medical monitoring and training requirements.

Personnel must have successfully completed training, which meets the provisions established in 29 CFR 1910.120 (e)(2) and (e)(3) (40-hour initial training). As appropriate, personnel must also have completed annual refresher training IAW 29 CFR 1910.120 (e)(8); each person's most recent training course must have been completed within the previous 365 days. Personnel must also have completed a physical exam IAW the requirements of 29 CFR 1910.120(f), where the medical evaluation includes a judgment of the employee's ability to use respiratory protective equipment and to participate in hazardous waste site activities.

4.1.1 Hazardous Waste Operations and Emergency Response Medical Surveillance

Site personnel are required to participate in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f) and 1926.65(f). Current copies of training certificates and statements of medical program participation for on-site personnel will be maintained on-site. Personnel must also have completed a physical exam IAW the requirements of 29 CFR 1910.120 (f), where the medical evaluation includes a judgment of the employee's ability to use respiratory protective equipment and to participate in hazardous waste site activities.

If site monitoring procedures indicate that a possible exposure has occurred above the Occupational Safety and Health Administration (OSHA)-permissible exposure limit (PEL), employees may be required to receive supplemental medical testing to document symptoms specific to exposure with the particular materials present.

4.2 Site-Specific Safety Training

All personnel performing field activities at the site will be trained IAW the APP and will sign the Acknowledgement Form in Section 11.0 of this SSHP.

In addition to the general H&S training programs:

- Workers will be instructed on the contents of applicable portions of this SSHP and any supplemental H&S information developed for the tasks to be performed.
- Workers will be instructed on the proper ultraviolet (UV) radiation protection measures.
- Workers will be informed about the potential routes of exposure, protective clothing, precautionary measures, and symptoms or signs of chemical exposure and heat stress.
- Workers will be made aware of task-specific physical hazards and other hazards that may be encountered during site work. This includes any client-specific required training for H&S.
- Workers will be made aware of fire prevention measures, fire extinguishing methods, and evacuation procedures.

The site-specific training will be performed prior to the worker performing the subject task or handling the impacted materials and on an as-needed basis thereafter. Training will be conducted by the UXOSO (or his/her designee) and will be documented.

4.2.1 Daily Safety Meetings

Personnel will read and sign the daily site safety log. Daily, the UXOSO will ensure that the anticipated site hazards for that day are summarized and explained to all personnel and that personnel are aware of the precautions they must take to minimize their exposure to those hazards. Reading and signing the daily safety log will occur at the start of each work shift. All new employees must read and become familiar with the SSHP and sign the daily site safety log.

4.2.2 Competent-Person Training Requirements

OSHA defines a competent person as "*one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.*" Further, by way of training and/or experience, a competent person is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, and has the authority to correct them. Some standards add additional specific requirements that must be met by the competent person. In order to complete the planned SOW, an OSHA-designated Competent Person (CP) must be on-site to perform the required daily inspections of equipment and/or operations. The UXOSO, or their designee, is considered to be the CP.

For tasks where the applicable OSHA standard requires a competent person to have additional training and/or experience (e.g. excavation), the CP for that task will be designated in the applicable AHA.

4.3 Hazard Communication

Section 5.2 provides information concerning the materials that may be encountered as environmental contaminants during the site work activities. In addition, any organization wishing to bring any hazardous material onto any MMG-TLI JV-controlled work site must first provide a copy of the item's Safety Data Sheet (SDS) to the UXOSO for approval and filing (the UXOSO will maintain copies of all SDSs on-site). SDSs may not be available for locally obtained products, in which case some alternate form of product hazard documentation will be acceptable. All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to all SDSs.

All containers on-site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential H&S hazards (flammability, reactivity, etc.).

4.4 Confined Space Entry

Confined Space Entry is not anticipated for the planned tasks.

4.5 Mustard Agent Avoidance

Recovered chemical warfare materiel (RCWM) is not anticipated to be encountered. However, in the event RCWM is encountered or suspected, all personnel will immediately withdraw upwind to a safe location, and the MTL or SUXOS will immediately notify the United States Army Corps of Engineers (USACE) Project Manager (PM) and Ordnance and Explosives Safety Specialist (OESS).

4.6 Hazardous, Solid, or Municipal Waste

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of IAW applicable Federal, State, and/or local regulations.

4.7 General Safety Rules

All site personnel shall adhere to safe work practices during site operations in addition to following housekeeping, sanitation, and personal hygiene requirements. Specific safety guidance is listed below.

4.7.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.7.2 Smoking, Eating, Drinking, or Drug Use

Smoking, eating, and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking).

Consumption or possession of alcoholic beverages and/or use of illicit drugs are prohibited at any MMG-TLI JV site. IAW EM 385-1-1, 01.C.02, while on duty, employees shall not use or be under the influence of alcohol, narcotics, intoxicants, or similar performance or mind-altering substances. Employees found to be under the influence of or consuming such substances will be immediately removed from the job site. Additionally, any employee under a physician’s treatment and taking prescribed narcotics or any medication that may prevent one being ready, willing, and able to safely perform position duties shall provide a medical clearance statement to his supervisor.

4.7.3 Personal Hygiene

The following personal hygiene requirements will be observed:

<u>Water Supply</u>: A water supply meeting the following requirements will be utilized:

> *Potable Water*: An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.
>
> *Non-Potable Water*: Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

Non-Potable Water
Not Intended for Drinking Water Consumption

<u>Toilet Facilities</u>: Portable sanitary facilities with at least one unit for every 20 workers will be provided and maintained IAW 29 CFR 1926.51 and 1910.141. The sanitary facilities will be maintained and serviced at regular intervals and located adjacent to or near the work site.

<u>Washing Facilities</u>: Employees will be provided washing facilities at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the Exclusion Zone, prior to breaks, and at the end of daily work activities.

4.7.4 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on-site can serve as “buddies” for MMG-TLI JV personnel. Under no circumstances will any employee be present alone in a controlled work area.

4.7.5 Heat and Cold Stress

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress. For additional requirements, refer to Section 5 of this SSHP.

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first aid treatment procedures for the victim, and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress.

4.7.6 Ultraviolet Radiation Protection

To protect against exposure to UV radiation, workers will observe the following requirements:

1. All workers will wear sunglass-type safety glasses when needed while working outdoors during daylight hours.
2. Workers will utilize a commercial sunblock with a minimum solar protection factor (SPF) of 30 or higher.
3. Wide-brim hats/hard hats are recommended as they provide additional UV protection.

4.8 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe and to assist in correcting these conditions. Whenever the UXOSO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the UXOSO is authorized and required to stop work, which shall be immediately binding on all affected MMG-TLI JV employees and subcontractors.

Upon issuing the stop work order, the SUXOS/UXOSO shall notify the HSD and implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the MMG-TLI JV PM and the HSD have concurred that workplace conditions meet acceptable safety standards.

4.9 Use of Utility Task Vehicles

Utility task vehicles (UTVs) are anticipated to be used for site operations at LHAAP. All personnel required to use a UTV in the performance of task work will be required to have documented training performed by the SUXOS/UXOSO or designee that familiarizes the operator with the use of all controls and proper moving, stopping, turning and other operating characteristics of the vehicle. The training will be IAW all the requirements found in EM 385-1-1, 18.J. All preventative maintenance, documentation, and equipment requirements IAW EM 385-1-1 will be adhered to.

5.0 HAZARD ASSESSMENT

5.1 Activity Hazard Analysis

Conducting an AHA is a technique used to identify hazards and hazard controls associated with a specific job function. AHAs focus on the relationship between the workers, the activity (or task), the resources required to complete the task, and the work environment. These variables must be evaluated to identify the potential hazards associated with the task. Once identified, steps can be taken to eliminate, reduce, or control the hazards to an acceptable risk level.

Section 2-2 of the APP describes the work activities or tasks anticipated to be performed during this project. Individual AHAs for these work activities or tasks can be found in Tab A of this SSHP.

5.1.1 Unanticipated Work Activities/Conditions

Operations at the site may require additional activities or tasks not identified in Section 2 or addressed in Tab A. Before performing any task not covered in this SSHP, an AHA must be prepared and approved by site safety personnel. Any new major activity or task not previously identified must also have its AHA approved by the HSD.

5.2 Environmental Contaminant Exposure Hazards

The following is a discussion of the hazards presented to personnel during this project from on-site chemical hazards known or suspected to be present on-site. Hazards associated with chemical products brought to the site during work operations are addressed separately under the Hazard Communication process described in Section 4.3.

5.2.1 Toxic and Hazardous Materials

Various media in certain areas have been contaminated by past industrial operations and waste management practices at LHAAP. Industrial operations involved the use of secondary explosives, rocket motor propellants, and various pyrotechnics, such as illuminating and signal flares and ammunition. Explosives included 2,4,6-trinitrotoluene (TNT) and black powder. Typical composite propellants were composed of a rubber binder, an oxidizer such as ammonium perchlorate, and a powdered metal fuel such as aluminum. Pyrotechnics were generally composed of an inorganic oxidizer such as sodium nitrate, a metal powder such as magnesium, and a binder. Other materials used in the industrial operations included acids, lubricants, and solvents; particularly trichloroethene (TCE) and methylene chloride.

Tab B of this SSHP provides a comprehensive list of constituents that may be encountered on remediation sites. The list identifies the chemical, physical, and toxicological properties of these constituents based on information from the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards found on Center for Disease Control website (http://www.cdc.gov/niosh/npg/).

5.3 Physical Hazards

The primary physical hazards for this project associated with the LHAAP field activities are listed below. The controls that will be implemented for specific task hazards will be addressed in the activity AHA.

5.3.1 Fatigue Management Plan

The field work resulting from the implementation of this project will be structured so that work hours do not:

- Exceed 10 hours a day for more than four consecutive days;
- Exceed 50 hours in a seven-day work week;

- Exceed 12 hours a day for more than three consecutive days, or
- Exceed 58 hours a week for sedentary (to include office) work.

For this project, duty days will be Monday through Friday and non-duty days will be Saturday and Sunday. This schedule may be altered upon approval of the MMG-TLI JV PM, MTL and USACE PM.

5.3.2 Heavy Equipment

Heavy equipment used on-site will be operated under strict adherence to the applicable OSHA regulations found in 29 CFR 1910; 29 CFR 1926; the requirements of EM 385-1-1, Section 16; and the following guidelines:

- The operation of heavy equipment will be limited to authorized personnel specifically trained in its operation.
- Prior to operation, the operator will visually inspect heavy equipment daily and report any abnormalities/deficiencies to the UXOSO or SUXOS.
- The operator will use the safety devices provided with the equipment, including seat belts, backup warning indicators, and horns, which will be required to be operable at all times.
- All personnel working around heavy equipment will wear reflective vests or other high visibility clothing.
- While heavy equipment is in operation, all personnel that are not directly required in the area will keep a safe distance from the equipment.
- The operator’s cab will be kept free of all non-essential items, and all loose items will be secured.
- Personnel will avoid moving into the path of operating equipment and areas blinded from the operator’s vision.
- When heavy equipment must negotiate in tight quarters or if operators of earth-moving equipment cannot see the bucket, a secondary person will be stationed to guide the operator.
- Additional riders will not be allowed on equipment unless it is specifically designed for that purpose (i.e., there is an additional seat with a seat belt).
- Personnel operating heavy equipment will use hearing protection when required.

5.3.3 Hand and Power Tools

Power tools will be of a manufacturer listed by a nationally recognized testing laboratory for the specific application for which they are to be used. Hand and power tools will be used, inspected, and maintained IAW the manufacturer’s instructions and recommendations and will be used only for the purposes for which designed. A copy of the manufacturer’s instructions and recommendations will be maintained with the tools. Hand and power tools will be inspected, tested, and determined to be in safe operating condition prior to use. Continued periodic inspections will be made to assure safe operating condition and proper maintenance. All hand tools will be in good repair and with all required safety devices installed and properly adjusted. All hand and power tool operations will be conducted IAW OSHA 29 CFR 1926 Subpart I. Use of improper or defective tools can contribute significantly to on-site accidents. Therefore, the requirements outlined in EM 385-1-1, Section 13, and the following shall be observed when using hand tools:

- Inspect hand tools for defects prior to each use.
- Remove defective hand tools from service and repair or properly discard them.
- Select and use tools in the manner for which they were designed.

- Be sure of safe footing and grip before using any tool.
- Do not use tools that have split handles, mushroom heads, worn jaws, or other defects.
- Wear gloves whenever they increase gripping ability or if cut, laceration, nip, pinch, or puncture hazards may exist during the use of hand tools.
- Wear safety glasses or a face shield if use of tools presents an eye/face hazard.
- Do not use makeshift tools or other improper tools.
- When working overhead, secure tools to ensure that they cannot fall on someone below.
- Use non-sparking tools where there are explosive vapors, gases, or residue.

If hand tools become contaminated, properly decontaminate, bag, mark, and hold for disposition.

5.3.4 Overhead and Buried Hazards

LHAAP will identify the locations of all underground utilities prior to any excavation activities. Damaging underground utilities during field activities could lead to electric shock, explosion, and serious injury. LHAAP requires that an **Excavation Permit be initiated for all excavation activities**. Prior to initiating work activities, the project SUXOS/UXOSO shall verify that no part of an overhead or underground utility is located so that the performance of the planned activities may bring any tool, equipment, or personnel into physical or electrical contact with the utility. Whenever possible, all circuits adjacent to the planned activity shall be de-energized. If de-energizing the circuit is not possible or practical, the minimum safe clearance will be maintained for all operations. Minimum safe clearance distance for energized overhead electric lines are listed in EM-385-1-1, Table 11-1. If de-energizing is possible, no work will start until power has been shut off and positive means have been taken to prevent the lines from being energized.

5.3.5 Grounding

All electrical circuits will be grounded IAW National Electric Code (NEC) and National Electric Safety Code (NESC) regulations. Any conductor used as a ground will be clearly identifiable and distinguishable from all other conductors. Any grounded conductor or grounding terminal on a receptacle, cord, or other device will not be utilized for any purpose other than grounding. All grounding rods will be tested with a suitable earth/ground resistance tester to ensure sufficient resistance (25 ohms or less) and current-carrying capacity so the fuse or breaker is allowed to interrupt the circuit and dissipate any current load to which it may be subjected in normal use.

All portable tolls, lights, or devices will utilize three-conductor, grounded cord sets unless protected by an approved system of double insulation.

All receptacle outlets (125-volt, 15-, 20-, 30-amperage and greater) that provide temporary electrical power during the project shall have ground-fault circuit-interrupter (GFCI) protection for personnel. GFCI protection shall be provided on all circuits serving portable electric hand tools or semi-portable electric power tools.

Prior to use, all equipment, receptacles, electrical power tools, portable light strings, cord sets, etc., will be inspected and instrument tested by a qualified person to ensure ground circuit continuity. No equipment, tool, or device will be put into service if damaged.

5.3.6 Traffic Safety

In order to ensure the safety of pedestrians, local traffic, and site workers, traffic control measures will be established for the site activities that may be required in high-traffic zones, streets, parking lots, or other locations where vehicular traffic may present a potential hazard to workers. All individuals working on this site must wear a Type II or Type III reflective traffic safety vest when working in traffic areas. All traffic routes and traffic diversion measures such as road closures, lane closures, and the establishment of barricades or other traffic diversion signals will meet the minimum requirements identified in EM 385-1-1, Section 8. High-traffic areas are not anticipated during performance of this project. However, traffic control/road guards will be used when performing planned explosive disposal operations. Additional traffic control measures include the following:

- Personnel working on-site will obey all posted speed limits. The maximum speed limit is 25 miles per hour (mph) for roads that are not posted. All personnel will be made aware of and abide by speed limits.
- Seatbelts are required for drivers and passengers. The driver will assume responsibility for all passengers wearing seatbelts.
- Cell phone use is not permitted while driving.

5.3.7 Excavation and Trenching Safety

Excavation of soil presents several potential worker health and safety hazards including physical hazards associated with heavy equipment such as backhoes, trucks, and noise hazards. OSHA standards for excavations found in 29 CFR 1926 Subpart P shall be followed.

Excavation will be performed in a slow, careful manner. During excavation, all crew members will stand clear of the pit edges. All excavations over 5-ft in depth to be entered by field personnel will be sloped or shored to protect workers. Excavated material will be piled a safe distance from the excavation pit. Excavations must be flagged, barricaded, and secured to prevent unauthorized entry.

The backhoe will be operated exclusively by an experienced, qualified operator. During excavation all other crew members will stay clear of the backhoe. All heavy machinery will be equipped with audible reverse gear bells/sirens. Personnel working in the area will wear high visibility vests or other clothing so that they are more easily seen by the operator.

5.3.8 Slip, Trip, and Fall Hazards

A variety of conditions may exist that may result in injury from slips, trips, falls, and protruding objects. Slips and trips may occur as a result of wet, slippery, or uneven walking surfaces or by the general terrain and potential physical hazards (general debris, potholes, and loose gravel or soil). To prevent injuries from slips and trips, always keep work areas clean, keep walkways free of objects and debris, report/clean up liquid spills, always be aware of your surroundings, and watch where you are walking; and report/clean up liquid spills.

Protruding objects are any objects that extend into the path of travel or a working area that may cause injury when contacted by personnel. Always be aware of protruding objects, and when feasible, remove or label the protruding object with an appropriate warning.

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5.3.9 Materials Handling, Storage, and Disposal

Material handling devices will be available for the material handling needs of an activity and may include engineering devices, mechanical devices, handling aid devices, or means with protective equipment devices. Material handling will be done in accordance with OSHA 29 CFR 1926 Subpart H. In addition, procedures and AHAs will be followed for proper storage and disposal of hazardous materials.

The most common type of accident that occurs in material handling operations is the “caught between” situation when a load is being handled and a finger or toe gets caught between two objects. Rolling stock can shift and/or fall from a pipe rack or truck bed. Field personnel should wear appropriate safety shoes and gloves for work procedures.

5.3.10 Fire Hazards

The use of chemicals and fuel during work activities will present the possibility of fire hazards to personnel. In addition, flammable and combustible products in soil and water may be encountered during remediation activities. Fire prevention measures will be implemented for all field operations. To ensure adequate fire protection, the UXOSO/SUXOS will inspect the site to ensure that all flammable and combustible materials are being safely stored in appropriately configured storage areas and containers. The UXOSO/SUXOS will also ensure that no flammable or combustible materials are stored near any sources of ignition and that sources of ignition are removed a safe distance from storage areas. The AHA will identify specific fire hazards and the controls that will be implemented.

5.3.11 Heat Stress

As a primary preventive measure for heat stress, a pre-employment physical examination and written statement by a physician indicating fitness to withstand heat-related conditions will be required. In addition to the pre-employment physical examination, one or more of the control measures summarized in Table 5-1 can be used to help control heat stress and are mandatory for all MMG-TLI JV personnel and subcontractors. Heat stress monitoring will be conducted either by heart rate monitoring or the use of the wet-bulb globe temperature (WBGT) index.

Monitoring of heart rates will be utilized throughout the work day. Heart rates will be measured immediately prior to each rest period, and the following precautions will be taken based on the measured heart rate:

- If the heart rate is less than 90 beats per minute (bpm), the worker is probably not showing signs of heat stress. Continue monitoring.
- If the heart rate is greater than 90 bpm but less than 110 bpm and the difference in heart rates is 10 bpm or less, then the worker is probably experiencing some heat stress, and the work period should be reduced by one-third. Continue monitoring and apply first aid precautions in **Table 5-1**.
- If the heart rate is 110 bpm or higher, reduce the next work period by one-third. Continue monitoring and apply the first aid precautions in **Table 5-1**.

Wearing PPE puts site personnel at considerable risk of heat stress. Heat stress effects range from transient heat fatigue to serious illness and death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is one of the most common and potentially serious illnesses during field activities, preventive measures and alertness to the symptoms are vital.

Heat stress monitoring should commence when personnel are wearing PPE, including Tyvek coveralls, and the ambient temperature exceeds 21.1 degrees Celsius (°C) (70 degrees Fahrenheit [ºF]). However, if impermeable garments are not worn, heat stress monitoring should commence at 29.4 °C (85 ºF). The symptoms of heat stress are discussed in below in **Table 5-1**.

Table 5-1: Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description/Symptoms	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy, moist skin and may perspire profusely. The pulse is weak and fast, and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. Make the victim lie down, raise his or her feet 6–12 inches, and keep him or her cool by loosening all clothing. • If the victim is conscious, it may be helpful to give him or her sips of water. • Transport victim to a medical facility as soon as possible.
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 40 °C (104 ºF) or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly, and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool and shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his or her back with the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water or rubbing alcohol, if available. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide on-site treatment of the victim and proper transport to a medical facility.

If heart rate monitoring is not conducted, the wet-bulb globe temperature (WBGT) index method will be used to determine work/rest schedules. The daily work/rest schedules will be based on exposure threshold limit values (ETLV). **Table 5-2** provides suggested work/rest schedules for particular work demands and associated temperatures.

Table 5-2: Work and Rest Schedules per Work Demands and Temperature

	Acclimatized				**Unacclimatized**			
Work Demands	**Light**	**Moderate**	**Heavy**	**Very Heavy**	**Light**	**Moderate**	**Heavy**	**Very Heavy**
100% Work	29.5 °C (85.1 °F)	27.5 °C (81.4 °F)	26 °C (78.8 °F)		27.5 °C (81.5 °F)	25 °C (77 °F)	22.5 °C (72.5 °F)	
75% Work; 25% Rest	30.5 °C (86.9 °F)	28.5 °C (83.3 °F)	27.5 °C (81.5 °F)		29 °C (84.2 °F)	26.5 °C (79.7 °F)	24.5 °C (76.1 °F)	
50% Work; 50% Rest	31.5 °C (88.7 °F)	29.5 °C (85.1 °F)	28.5 °C (83.3 °F)	27.5 °C (81.5 °F)	30 °C (86 °F)	28 °C (82.4 °F)	26.5 °C (79.7 °F)	25 °C (77 °F)
25% Work; 75% Rest	32.5 °C (90.5 °F)	31 °C (87.8 °F)	30 °C (86 °F)	29.5 °C (85.1 °F)	31 °C (87.8 °F)	29 °C (84.2 °F)	28 °C (82.4 °F)	26.5 °C (79.7)

Notes:
°C = degrees Celsius
°F = degrees Fahrenheit

The following WBGT will be used depending on the required work clothing/PPE to be used at the site:

- Summer lightweight working clothing: WBGT = 0, no correction.
- Cotton coveralls: WBGT = -2, therefore decrease acclimatized/unacclimatized reference temperature (**Table 5-2**) by 2 °C (3.6 °F) and adjust work/rest schedule accordingly.
- Winter work clothing: WBGT = -4, therefore decrease acclimatized/unacclimatized reference temperature (**Table 5-2**) by 4 °C (7.2 °F) and adjust work/rest schedule accordingly.
- Water barrier, permeable (i.e., Tyvek): WBGT = -6, therefore decrease acclimatized/unacclimatized reference temperature (**Table 5-2**) by 6 °C (10.8 °F) and adjust work/rest schedule accordingly.

Fully encapsulating suit, gloves, boots, and hood (i.e., Level A PPE): WBGT = -10, therefore decrease acclimatized/unacclimatized reference temperature (**Table 5-2**) by 10 °C (18 °F) and adjust work/rest schedule accordingly. Additional information pertaining to heat stress control is further elaborated in TechLaw Consultants Standard Operating Procedure (SOP): Number: 09-06-07, Health and Safety Procedures, *Heat Stress Control*.

5.3.12 Cold Stress

Cold stress effects range from transient hypothermia to serious illness and death.

General hypothermia is an acute problem resulting from prolonged cold exposure and heat loss. If an individual becomes fatigued during physical activity, he/she will be more prone to heat loss, and as exhaustion approaches, sudden vasodilatation (blood vessel dilation) occurs with resultant in rapid loss of heat.

When vasoconstriction is no longer adequate to maintain body heat balance, shivering becomes an important mechanism for increasing body temperature by causing metabolic heat production to increase to several times the resting rate.

General physical activity acts to increase metabolic heat, with clothing providing the proper insulation to minimize heat loss. Only exposed body surfaces are then likely to be excessively chilled and frostbitten.

Most cold-related worker fatalities have resulted from failure to escape low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is a fall in the deep core temperature of the body.

Site workers should be protected from exposure to cold so that the deep core temperature does not fall below 36 ºC (96.8 ºF). Lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision-making, or loss of consciousness with the threat of fatal consequences. To prevent such occurrence, the following measures should be implemented:

- Site workers should be equipped with warm clothing such as mittens, heavy socks, etc., when the air temperature is below 40 ºF. Protective clothing, such as Tyvek or other disposable coveralls, may be used to shield employees from the wind.
- Clothing for warmth, in addition to chemical protective clothing, should include:
  - Insulated suits, such as whole body thermal underwear;
  - Wool socks or polypropylene socks to keep moisture off the feet;
  - Insulated gloves;
  - Insulated boots;
  - Insulated head cover such as hard hat, winter liner, or knit cap; and
  - Insulated jacket, with wind and water resistant outer layer.
- At air temperatures below 35 ºF, the following work practices must be implemented:
  - If the clothing of a site worker might become wet on the job site, the outer layer of clothing must be water impermeable.
  - If a site worker’s underclothing becomes wet in any way, the worker must change into dry clothing immediately. If the clothing becomes wet from sweating (and the employee is not uncomfortable), the employee may finish the task at hand prior to changing into dry clothing.
  - Site workers must be provided with a warm break area.
  - Consumption of hot liquids such as soups or warm, sweet drinks is encouraged during breaks. The intake of coffee and tea should be limited due to their circulatory and diuretic effects.
  - The buddy system shall be practiced at all times on-site. Any site worker observed with severe shivering shall leave the work area immediately.
  - Site workers should dress in layers with thinner lighter clothing worn next to the body.
  - Site workers should avoid overdressing when going into warm areas or when performing strenuous activities.

Employees handling liquids with a high vapor pressure, such as gasoline, methanol, or hexane, shall take special precautions to avoid soaking of gloves and clothing with those materials.

Additional information pertaining to cold stress control is further elaborated in TechLaw Consultants SOP Number: 09-05-06, Health and Safety Procedures, *Cold Stress Control*.

5.3.13 Noise

Noise exposure at or above the OSHA action level (85 decibels [dBA]) is possible during heavy equipment and power tool use. **Table 5-3** provides examples of typical noise levels and associated equipment.

Table 5-3: Typical Noise Level Measurements

Equipment	Noise Level (dBA)
Loader	77–106
Crane	78–103
Compactor	90–112
Dozier	86–106
Backhoe	85–104
Compressor	85–104
Scraper	97–112
Chainsaw	100–115
Jackhammer	100–115
Pile Driver	119–125
Concrete Saw	97–103
Grinder	106–110

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on-site. **Table 5-4** provides the level of hearing protection that will be required for personnel working around noise producing equipment.

Table 5-4: Noise Levels and Hearing Protection

Equipment	Noise Level (dBA)
Time-weighted average (TWA) less than 85 dBA	Hearing protection not required[1]
TWA from 86 to 89 dBA	Class C hearing protector
TWA from 90 to 95 dBA	Class B hearing protector
TWA from 96 to 105 dBA	Class A hearing protector
TWA from 106 to 110 dBA	Class A earplug plus Class A or Class B earmuff

Table 5-4: Noise Levels and Hearing Protection

Equipment	Noise Level (dBA)
TWA greater than 110 dBA	Class A earplug plus Class A or Class B earmuff and limited exposure

Notes:

[1] It must be stressed that there is no dividing line whereby regular noise exposure below a TWA of 85 dBA is considered “safe” and above this level is “unsafe.” The majority of individuals who are regularly exposed to noise levels between 80–85 dBA will not experience noise-induced hearing loss but there may be some susceptible individuals who will experience this loss. This possibility should be discussed with any individual whose TWA is between 80–85 dBA and appropriate hearing protection will be provided on request.

5.3.14 Use of Utility Task Vehicles

UTVs are anticipated to be used for site operations at LHAAP. All personnel required to use a UTV in the performance of task work will be required to have documented training performed by the UXOSO or designee, which familiarizes the operator with the use of all controls and proper moving, stopping, turning and other operating characteristics of the vehicle. The training will be IAW all the requirements found in EM 385-1-1, 18.J. Additionally, all preventative maintenance, documentation, and equipment requirements IAW EM 385-1-1 will be adhered to.

5.4 Biological Hazards

Biological hazards are any virus, bacteria fungus, parasite, or living organism that can cause a disease in human beings. Diseases transmitted from animals to humans can occur and infectious and parasitic diseases can also result from exposure to contaminated water, insects, or infected people.

5.4.1 Snakes

LHAAP is located in a region of the State that may contain a variety of poisonous snakes including the rattlesnake, copperhead, cottonmouth and the coral snake. Generally these snakes are not aggressive unless disturbed, although the cottonmouth can be highly defensive and not inclined to get out of one’s way.

Good practices in areas where snakes are present include:

- Wear over-the-ankle or calf-high boots and loose-fitting long pants or chaps.
- Do not step or put your hands where you cannot see. Do not place your hands on unseen ledges or into animal holes.
- Do not turn rocks or boards over with bare hands. Use a tool.
- Step on logs and rocks, never over them, and be especially careful when climbing rocks.
- Avoid walking through dense brush or willow thickets; if you must walk in these areas use a long stick or branch to beat the brush before you as you go.
- The location of a physician with snakebite treatment is identified in **Figure 10-1**.
- Personnel who are allergic to horses should notify the UXOSO prior to beginning fieldwork, as some anti-venoms are manufactured in horses.

What to do in case of a snake bite:

- Call 911.

- Try to remain calm and inactive.
- If possible, from a safe distance take a photograph of the snake for identification. The hospital will need to know what type of snake has caused the bite. Only identify or photograph the snake if it remains visible from a safe distance.
- Get to a hospital or doctor as soon as possible (have someone else drive).
- Loosen or remove any restrictive clothing or jewelry (e.g., shoes, watch) from the area near the bite.
- Watch the victim for signs of shock. Treat, if necessary, by lying flat with feet elevated and cover with warm clothes or blanket.

What not to do:

- Do not make incisions over the snakebite.
- Do not constrict the flow of blood.
- Do not immerse a limb in ice water.
- Do not elevate the bitten area (this will increase the flow of venom to other tissues).
- Do not use your mouth or other suction-type tools to extract venom. Sucking out the venom is no longer a recommended practice and wastes valuable time.
- Do not run or carry unnecessary items as you go for help to avoid elevating your pulse rate.
- Do not try to catch or kill the snake.
- Do not administer any pain medications or antihistamines unless instructed by a doctor or emergency medical technician.

Though uncommon, snake bites do occur. The first thing to do if bitten is to stay calm. Generally, the most serious effect of a rattlesnake bite to an adult is local tissue damage, which needs to be treated. Get to a doctor as soon as possible but stay calm. Frenetic, high-speed driving places the victim at greater risk of an accident and increased heart rate.

5.4.2 Rodents and Disease

Mammals such as chipmunks, ground squirrels, rats, raccoons, and beavers have been known to harbor fleas carrying bubonic plague. Their bites can also transmit rabies and infections. Larger mammals inhabiting the state include the feral hog and black bear. Some animals pose a special problem because people tend to try to feed them or pet them; the increased contact brings a greater possibility of danger. Avoid wildlife when possible. Identify an evacuation route and shelter when working in areas where wildlife may be encountered.

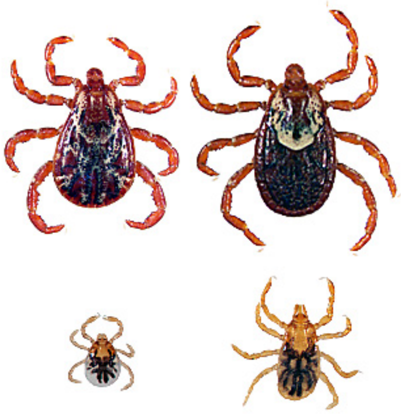
In addition, Hantavirus may also be of concern where rodents (rats and mice) may be present. Hantavirus is a disease transmitted from infected rodents via aerosols from saliva or excretion. Symptoms include sudden onset of fever, myalgias, aching, bleeding of internal organs, shock, and renal syndromes. Field personnel can protect themselves by donning appropriate PPE (i.e., Level C) avoiding contact with animal droppings, avoiding hand-to-mouth contact, decontaminating or disposing of PPE, and frequently washing hands and face thoroughly. Also, avoid disturbing dried droppings or urine, which can be stirred up in dust and inhaled.

5.4.3 Tick-Borne Disease

Lyme disease is an illness caused by a bacterium that may be transmitted by the bite of a tick. Lyme disease typically occurs in the summer months and is characterized by a slowly expanding red rash, which develops within a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage, treatment by a physician is usually effective, but if left alone, these early symptoms may disappear, and more serious problems may follow. The most common late symptom is arthritis. Other problems include meningitis and neurological and cardiac abnormalities. Some people do not get the characteristic rash but progress directly to the later manifestations. Treatment of follow-on symptoms is more difficult than early symptoms and is not always successful.

The following precautions can minimize the chance of being bitten by a tick:

- Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists;
- Wear light-weight, disposable coveralls;
- Wear light-colored clothing so ticks can be easily spotted;
- Wear tick repellent;
- Inspect clothing frequently while in tick habitat;
- Periodically during the workday, inspect yourself for the presence of ticks;
- Inspect head and body thoroughly when returning from the field;
- Remove, segregate, and launder field clothing as soon as possible after fieldwork; and
- Shower and conduct a full-body tick check as soon as possible after fieldwork.



Wood Ticks

5.4.4 Spiders

Spiders of most concern are the Black Widow and the Brown Recluse or Violin Spider. The symptoms of a spider bite are:

- Slight local reaction or severe pain produced by nerve toxin;
- Profuse sweating; and
- Nausea and painful cramps in the abdominal muscles.

Personnel should use extreme caution when lifting manhole covers, sumps, etc., since spiders can typically be found in these areas. If bitten by a spider, render basic first aid. Victims that exhibit allergic reactions should call a physician or be taken immediately to the nearest location where medical treatment is available.

Black Widow

Brown Recluse

5.4.5 Animal or Insect Bites

Animal bites or stings are usually nuisances (localized swelling, itching, and minor pain) that can be handled by First Aid treatment. The bites of certain snakes, lizards, spiders, and scorpions contain sufficient poison to warrant medical attention. In addition, there are several species of caterpillars that contain stinging hairs that may cause a rash on contact or respiratory distress if the hairs are inhaled.

There are diseases that can be transmitted by insect and animal bites (e.g., Rocky Mountain Spotted Fever, Lyme disease [Ticks], rabies [mainly dogs, skunks, raccoons, and foxes], malaria, and equine encephalitis [mosquitoes]). The greatest hazard and most-common cause of fatalities from animal bites, particularly bees, wasps, fire ants and spiders is from a sensitivity reaction. Shock due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems

If an employee has a history of allergic reactions to bites, they should have their prescribed treatment with them, and the supervisor or UXOSO should be informed where it is located. Anyone stung or bitten will be required to stop work while that person is observed for signs of severe swelling, shortness of breath, nausea, or shock. If there is any doubt, medical attention will be obtained.

5.4.6 Plant Life

Plants to avoid are of the Poison Ivy group, which includes Poison Oak and Poison Sumac. The most distinctive features of Poison Ivy and Sumac are their leaves, which are composed of three leaflets each. These plants produce a severe rash characterized by redness, blister, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. The rash begins within a few hours after exposure but may take from 24 to 48 hours to develop. Render basic first aid procedures if someone contacts a poisonous plant.

Poison Ivy

Poison Oak

5.4.7 Bloodborne Pathogens

Bloodborne pathogens may be a concern when rendering first aid. There is the potential for worker injury during site tasks, resulting in possible worker exposure to bloodborne pathogens (i.e., hepatitis B virus and human immunodeficiency virus). To avoid occupational exposure, all site personnel shall be trained IAW 29 CFR 1910.1030, *Occupational Exposure to Bloodborne Pathogens*; provided appropriate PPE;

and provided appropriate vaccinations as directed by TechLaw Holdings SOP 09-11-04, *Bloodborne Pathogens Exposure Control Plan*.

5.4.8 Sunburn

Personnel working in direct sunlight are encouraged to wear tightly-woven clothing that blocks light and apply sunscreen per manufacturer's directions to all unprotected skin surfaces. The use of wide-brimmed hats is recommended. The benefits of preventing sunburn and skin cancer are self-evident. Sunscreen will be provided for use by project personnel while working on-site. Personnel are encouraged to examine their body monthly for early detection of skin cancers.

5.4.9 COVID-19

COVID-19 is a respiratory illness caused by a novel coronavirus (SARS-CoV-2). Current information about symptoms can be found on the Centers for Disease Control and Prevention (CDC) website (www.cdc.gov). COVID-19 Symptoms include:

- Cough
- Shortness of breath or difficulty breathing
- Fever
- Chills
- Muscle pain
- Sore throat
- New loss of taste or smell
- Other gastrointestinal symptoms like nausea, vomiting, or diarrhea

The virus is thought to mainly spread through droplets expelled when someone breathes, talks, sings, coughs, sneezes, etc. In most instances of transmission, close contact (sometimes called "face-to-face interaction") is believed to be responsible for spreading the virus when an uninfected individual breathes in the droplets from an infected individual. Close contact is when a person is within 6 feet of another person for a prolonged period of time. Although it's not thought to be the primary mode of transmission, COVID-19 can also spread when a person touches a surface where droplets have settled and then touches their nose, mouth or eyes.

The COVID-19 information in this document is evolving and subject to circumstances where health guidance may change. Therefore, it is important to follow CDC, state, and local guidelines to minimize exposure during office and fieldwork. Additional information pertaining to COVID-19 is further elaborated in the most recent revision of TechLaw SOP Number: 09-21, Health and Safety Procedures, COVID-19.

5.5 RADIOLOGICAL HAZARDS

There are no known radiological hazards associated with the current scope of work.

5.6 CONFINED SPACES

No confined space work is anticipated within the current scope of work.

5.7 MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

MMG-TLI JV employees will not handle or manage MEC or MC unless trained and authorized. MMG-TLI JV employees will practice MEC avoidance and will in no way perform clearance activities unless trained and authorized. Non-munitions-related field work (e.g., soil sampling, surveying) within LHAAP will only occur with an appropriately trained and authorized escort. If MEC is encountered:

- Stop any movement in the vicinity of the item. Some munitions are sensitive to motions and could explode if approached;
- Do not move or disturb MEC;
- Note the location, the direction, landmarks, or other features that would aid in the relocation of the item. Mark the area if possible;
- Record the size, shape, color, and any unique markings on the item, but do not move the item to obtain this information;
- Evacuate the immediate area. Retrace your steps to avoid encountering any other MEC that may be in the vicinity;
- Report the MEC to the SUXOS and UXO personnel. The SUXOS or UXO personnel will then contact emergency personnel as needed;
- Remain at the site until emergency response personnel arrive. Be prepared to give a complete description of the item(s) and directions to the location; and
- Radios shall not be used within the MSD from MEC as specified in Department of the Army (DA) Pamphlet (PAM) 385-64, Section 3, paragraph 17-15.g (e.g., the MSD of 5 ft is prescribed for citizens band radios or walkie-talkies). Cell phones shall not be used within the vicinity of suspect ordnance items (EM 385-1-1).

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6.0 EXPOSURE MONITORING PROCEDURES

Monitoring procedures will be employed during site characterization activities to assess employee exposure to chemical and physical hazards. Monitoring will consist primarily of on-site determination of various parameters (e.g., heat stress effects) but may be supplemented by more sophisticated monitoring techniques, if necessary.

6.1 REAL-TIME EXPOSURE MEASUREMENT

Other than heat and/or cold stress hazards, real-time exposure monitoring is not anticipated for the munitions response at LHAAP within the current scope of work.

6.2 Hearing Conservation

MMG-TLI JV will administer a hearing conservation program to all employees potentially exposed to noise above 85 dBA. The MMG-TLI JV program includes the following provisions:

- A baseline audiogram shall be provided to the employee within 30 days of an employee’s first noise exposure at or above the action level of 85 dBA TWA. This audiogram shall establish a baseline against which subsequent audiograms may be compared.
- Audiometric tests shall be performed by a technician currently certified by the Council for Accreditation in Occupational Hearing Conservation who meets the requirements outlined in OSHA 29 CFR 1910.95(g) (3).
- An annual audiogram shall be obtained thereafter for each employee exposed at or above the action level of 85 dBA TWA.
- If the annual audiogram shows that an employee has suffered a significant threshold shift (STS), the supervisor and employee shall be notified in writing within 21 days and the employee re-tested within 30 days. The employee must use hearing protection devices in the interim prior to the re-test. An audiologist, otolaryngologist, or occupational physician shall review the confirmed significant threshold shift re-test audiogram and shall determine if there is a need for further evaluation. The health professional shall notify the employee within 21 days of a significant threshold shift determination of the results and recommendations. If the re-test done within the 30 day period does not show a significant threshold shift, the new test may be considered the regular annual test and mandatory use of the PPE from perceived STS is discontinued. If the re-test confirms the significant threshold shift, the mandated use of hearing protection devices is continued indefinitely.

MMG-TLI JV will fit employees initially with suitable hearing protection devices and provide hearing conservation training to employees in the hearing conservation program.

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7.0 PERSONAL PROTECTIVE EQUIPMENT

7.1 PERSONAL PROTECTIVE EQUIPMENT

The purpose of PPE is to provide a barrier that will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. Table 7-1 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual AHAs found in Tab A.

By signing this SSHP you are agreeing that you have been properly trained in the use, limitations, care, and maintenance of the protective equipment you will use at this project. If you have not received training on the proper use, care, and limitations of the PPE required for this project, contact the PM/MTL/SUXOS for the proper training prior to signing this SSHP.

Table 7-1: Personal Protective Equipment

TYPE	MATERIAL	ADDITIONAL INFORMATION
Minimum PPE		
Boots	Leather, high traction Waterproof (recommended)	American National Standards Institute (ANSI)-approved safety toe
Safety Glasses		ANSI-approved; ≥98% UV protection (outdoors)
Hard Hat		ANSI-approved; wide-brim recommended, required when overhead hazards exist
Work Clothing		No shorts/cutoff jeans or sleeveless shirts
Additional PPE		
Safety Goggles		ANSI-approved; for work with flying debris and windblown dust
Safety Vest or clothing	ANSI Type II high-visibility	Fluorescent and must have reflective tape/be visible from all sides
Hearing Protection	Ear plugs and/or muffs	In hazardous noise areas or when operating heavy equipment
Gloves	Leather	If working with sharp objects or powered equipment
Gloves	Latex, Nitrile, Neoprene or Coated Butyl	Based on contaminant(s).
Coveralls/Face Shield	Coated Tyvek, Saranex	If splashing is a problem when collecting samples or decontaminating equipment.
Polyvinyl Chloride Raincoat		When chemical contaminate exposure is a potential during decontamination of equipment.
Sunscreen	SPF 30 or higher	Available for use as directed by the manufacturer

Face Protection		For decontamination tasks and/or brush cutting work during site preparation/vegetation clearance if using portable electric tools Safety glasses or goggles must be worn concurrently.
Insect repellant	Permethrin and DEET	When working in woods/brush areas
Cooling Vest		Use during potential heat stress activities
Cold Weather Gear		Hard hat liner, hand warmers, insulated gloves
Snake Chaps		Made available when working in known snake areas
Fall Protection	Harness	When working at heights above 6 feet.

7.2 PERSONAL PROTECTIVE EQUIPMENT DOFFING AND DONNING INFORMATION

The following information is to provide field personnel with helpful hints that, when applied, make donning and doffing of PPE a more safe and manageable task:

- **Never** cut disposable booties from your feet with utility or pocket knives. This has resulted in workers cutting through the booty and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. The recommendation is to use a pair of scissors or a package/letter opener (cut above and parallel with the work boot) to start a cut in the edge of the booty, then proceed by manually tearing the material down to the sole of the booty for easy removal.
- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a “buddy” check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.
- **Never** perform personal decontamination with a pressure washer.

8.0 SITE CONTROL

8.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location and, if required, will be established directly prior to the work being conducted. Diagrams designating specific controlled work areas will be drawn on site maps, posted in the support vehicle or trailer, and discussed during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made.

8.2 Controlled Work Areas

Each HAZWOPER-controlled work area will consist of the following three zones:

1. Exclusion Zone: Contaminated work area.
2. Contamination Reduction Zone (CRZ): Decontamination area.
3. Support Zone: Uncontaminated or “clean area” where personnel should not be exposed to hazardous conditions.

Each zone will be periodically monitored IAW the air monitoring requirements established in this SSHP. The Exclusion Zone and the CRZ are considered work areas. The Support Zone is accessible to the public (e.g., vendors, inspectors).

8.2.1 Exclusion Zone

The Exclusion Zone is an area used to protect the public and nonessential personnel from inadvertent detonations. Exclusion Zones will be established to minimize the risk of human exposure to explosive hazards. This area must be clearly marked with hazard tape, barricades, or cones or enclosed by fences or ropes. Only personnel involved in work activities and meeting the requirements specified in the applicable AHA and Sections 4.1 and 4.2 will be allowed in an Exclusion Zone.

Access to Exclusion Zones will be restricted to essential personnel and authorized visitors escorted by UXO personnel. Positive controls (e.g., signs [multilingual, as appropriate], fencing, guards), appropriate to the project, shall be used to prohibit entry of unauthorized personnel.

The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with munitions response activities. The UXOSO will determine the minimum distances of the exclusion zones. Below are examples of minimal distance to be used.

- The MSD for any encountered MEC/MPPEH procedures will be IAW the ESP, Defense Explosive Safety Regulations (DESR) 6055.09, EM 385-1-97, and MMG-TLI JV MEC SOP Nos. 18-02-01, 18-03-01, and 18-04-03.
- **Potholing and Trenching Activities.** A distance of 25 feet will be cleared in all directions from the backhoe and the location where the excavated soil is deposited.

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the Exclusion Zone and CRZ). If such an entry should occur, the trespasser should be immediately escorted outside the area, and all munitions response activities work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the CRZ only).

8.2.2 Contamination Reduction Zone

A CRZ will not be required for this project, as it is unlikely that gross levels of contamination will be encountered requiring a personnel decontamination station.

8.2.3 Support Zone

The Support Zone is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. Public access beyond the Support Zone will be prevented during munitions response operations.

Employees will establish a Support Zone (if necessary) at the site before the commencement of site activities. The Support Zone would also serve as the entry point for controlling site access.

8.3 Site Access Documentation

All personnel entering the site shall complete the “Site Entry/Exit Log” located at the Support Zone (site office or primary site support vehicle).

8.3.1 Visitor Access

Visitors to any HAZWOPER-controlled work area must comply with the health and safety requirements of this SSHP and demonstrate an acceptable need for entry into the work area. All visitors desiring to enter any controlled work area must observe the following procedures:

1. A written confirmation must be received by MMG-TLI JV documenting that each of the visitors has received the proper training and medical monitoring required by this SSHP. Verbal confirmation can be considered acceptable provided such confirmation is made by an officer or other authorized representative of the visitor’s organization.
2. Each visitor will be briefed on the hazards associated with the site activities being performed and acknowledge receipt of this briefing by signing the appropriate tailgate safety briefing form.
3. All visitors must be escorted by a MMG-TLI JV employee.

Only visitors that are deemed essential personnel can be within the Exclusion Zone when munitions response activities are occurring. Munitions response work will cease for all other visitors. If the site visitor requires entry to any Exclusion Zone but does not comply with the above requirements, all work activities within the Exclusion Zone must be suspended. Until these requirements have been met, entry will not be permitted.

8.4 Site Security

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards;
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site;
- Prevent theft; and
- Avoid interference with safe working procedures.

To maintain site security during working hours:

- Maintain security in the Support Zone and at access control points;
- Establish an identification system to identify authorized persons and limitations to their approved activities;
- Assign responsibility for enforcing authority for entry and exit requirements;
- When feasible, install fencing or other physical barrier around the site;
- If the site is not fenced, post signs around the perimeter and whenever possible, use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures; and
- Have the SUXOS approve all visitors to the site. Make sure they have a valid purpose for entering the site. Have trained site personnel accompany visitors at all times and provide them with the appropriate protective equipment.

To maintain site security during off-duty hours (when necessary):

- If possible, assign trained, in-house technicians for site surveillance. They will be familiar with the site, the nature of the work, the site’s hazards, and any respiratory protection techniques.
- If necessary, use security guards to patrol the site boundary. Such personnel may be less expensive than trained technicians but will be more difficult to train in safety procedures and will be less confident in reacting to problems around hazardous substances.
- Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.
- Secure the equipment.

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9.0 DECONTAMINATION

9.1 Contamination Prevention

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure. During the use of hazardous chemicals or when potentially contaminated materials are encountered, contamination prevention protocols will be implemented. Procedures for contamination prevention for personnel include:

- Do not handle or touch contaminated materials directly;
- Make sure all PPE is free of cuts or tears prior to donning;
- Fasten all closures on suits, covering with tape if necessary;
- Take special care to protect any skin injuries. If open wounds exist on hands or forearms, handling chemicals or contaminated materials should be restricted or eliminated;
- Stay upwind of the contaminated area; and
- Do not carry cigarettes, gum, chewing tobacco, or cosmetics into the work area.

9.2 Decontamination Procedures

Personnel decontamination may be required by personnel conducting environmental sampling. Personnel will avoid contact with potentially contaminated media and will take all necessary precautions to prevent being splashed with liquid chemical products or potentially contaminated water. During sampling activities, personnel should also avoid contact with potentially contaminated equipment, media, chemical vapors, dusts, fumes, and mists. PPE, including gloves, boots, and clothing will help to prevent personnel from becoming exposed to contamination. Decontamination of PPE will help prevent hazardous materials from being transferred from protective clothing to the wearer or to other unprotected individuals that could become exposed. Section 7 contains additional information regarding PPE.

9.3 Sample Handling/Decontamination

All reusable equipment that comes into contact with potentially contaminated soil, water, or other material will be decontaminated prior to use at each sampling location. PPE, decontamination plastic, and similar waste material will be consolidated into contractor trash bags and placed in a solid waste dumpster. RDW, if generated, will be containerized in 55-gallon drums at the work site and later transferred to a designated storage area, to await characterization and proper disposal.

9.4 Equipment Decontamination

In general, equipment will be decontaminated as follows:

- Heavy equipment (e.g., direct-push equipment), trucks, shovels, and other brush-clearing equipment will be brushed off or washed with a high-pressure sprayer at the end of field activities or prior to leaving the work site.
- Sampling equipment will be cleaned with water and LiquiNox (or equivalent), rinsed with deionized water, and allowed to air dry prior to sampling and when sampling is complete.
- Monitoring equipment will be protected from contamination to the extent possible using a protective covering such as a plastic bag, when necessary. Any direct contamination will be removed with a disposable wipe.

9.5 Decontamination in Medical Emergencies

In the event of physical injury or other serious medical concerns, immediate first aid is to be administered in lieu of further decontamination efforts.

10.0 EMERGENCY RESPONSE PLANNING

10.1 Emergency Action Plan

Although the potential for an emergency to occur is remote, an Emergency Action Plan (EAP) has been prepared for this project should such critical situations arise. The EAP will be reviewed by all personnel prior to the start of field activities.

Three major categories of emergencies could occur during site operations:

1. Illnesses and physical injuries (including injury-causing chemical exposure)
2. Catastrophic events (fire, explosion, earthquake, or chemical)
3. Safety equipment problems

10.1.1 Emergency Coordinator

The UXOSO will serve as the Emergency Coordinator (EC) and the SUXOS as the alternate EC until relieved by LHAAP personnel. The EC is responsible for:

- Updating **Table 10-1** (Emergency Planning) below, as needed, throughout the duration of the field effort.
- Contacting and meeting with the appropriate local emergency response authorities.
- In the event that evacuation of the general public is required due to either normal site operations or an emergency event, the UXOSO is responsible for contacting the appropriate local officials who execute and coordinate an evacuation. Emergency contacts are listed in **Table 10-2**.
- Conducting site-specific training for all site personnel prior to initiating any site activity involving safety and health hazards. Training relevant to emergency response includes the subjects listed below:
  - ➢ Emergency chain-of-command;
  - ➢ Communication methods and signals;
  - ➢ Location of rally point;
  - ➢ Location and use of emergency equipment and PPE;
  - ➢ Removing injured personnel from the site; and
  - ➢ Emergency contacts, phone numbers, and hospital route.
- Ensuring all personnel are present or accounted for at the rally points.
- Once the UXOSO has been informed that an emergency situation exists, the following actions will be taken:
  - ➢ The UXOSO will contact all field teams using radio communication.
  - ➢ The UXOSO will instruct personnel directly involved to render first aid if needed and to return to the rally point if possible.
  - ➢ The UXOSO will instruct teams not directly involved in the incident to report to the rally point and stand by for instructions.
  - ➢ The UXOSO will notify off-site emergency personnel if required.
  - ➢ The UXOSO will brief responders on the following:
    - What occurred and when;
    - Where on-site the incident occurred;
    - Number of personnel involved;
    - Existing hazards; and
    - Any pertinent actions to be taken.
- Following an emergency, the UXOSO will coordinate completion of the following:
  - ➢ Restocking and cleaning all equipment and supplies utilized or damaged in the emergency;
  - ➢ Conducting investigation and perform reporting in accordance with Section 10.1.5 below;

- Working with the project HSD, reviewing and revising as needed the site operational procedures and, if necessary, updating the APP to reflect the new procedures; and
- Communicating any new or revised site operational procedures to the project site personnel.

10.1.2 Site-Specific Emergency Procedures

Prior to the start of site operations, the EC will complete **Table 10-1** with any site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

Table 10-2: Emergency Planning

Emergency	Evacuation Route	Muster Location
Chemical Spill	• Upwind 50 ft	• Main support vehicle (or on-site office, if applicable)
Fire/Explosion	• Exit work area	• Main support vehicle (or on-site office, if applicable)
Tornado or Earthquake	• If outside, shelter in place (do not outrun)	• Designated by the UXOSO
Lightning	• Move to shelter or vehicle	• Main support vehicle (or on-site office, if applicable)
Additional Information		
Communication Procedures	Voice communication or mobile phone to crew members	
Cardiopulmonary resuscitation (CPR)/First Aid Trained Personnel	At least two employees per shift	
Site-Specific Spill Response Procedures	Spill response will be coordinated by UXOSO as the Response Manager (RM)	

10.1.3 Emergency Equipment and First Aid

A supply of emergency PPE and equipment will be maintained in sufficient quantities to ensure an adequate supply for emergency response. All emergency equipment will be fully stocked and readily accessible as needed. The following emergency supplies will be available and maintained/set up in a vehicle used by each field team:

- Industrial first aid kit (one 16-unit kit that complies with American National Standards Institute Z308A for every 25 persons or less)
- Bloodborne pathogen precaution kit with CPR mouth shield
- Instant cold packs
- Portable emergency eye wash bottles
- Fire extinguishers
- Nitrile gloves
- Spill control/absorption supplies

- Soap or waterless hand cleaner and towels
- First Aid and CPR Instruction Manuals
- Burn blanket

10.1.4 Spill Containment Procedure

Work activities may involve the use of hazardous materials (i.e., fuels, solvents), drums, or other containers. Where these activities exist, a site-specific Spill Reporting Card will be developed. The following procedures will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers;
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e., speedy dry) shall be available at each work site (more as needed).

- All hazardous commodities in use (i.e., fuels) shall be properly labeled.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- For drums/containers, follow procedures to minimize spillage.

10.1.5 Safety Accident/Incident Reporting

All accidents and incidents that occur on-site during any field activity will be promptly reported to the UXOSO, the MTL, and the MMG-TLI JV Program Manager. The MMG-TLI JV Program Manager will report accidents as soon as possible but not more than 24 hours afterwards to the USACE PM and/or Contracting Officer's Representative (COR). The LHAAP Environmental Management Office (EMO) PM is also to be notified of all accidents and incidents that occur at the facility.

If any MMG-TLI JV employee is injured and requires medical treatment, the SUXOS or UXOSO will contact the MMG-TLI JV HSD **immediately**. The SUXOS or UXOSO will initiate a written report, using the ***Incident Report*** form. The SUXOS or UXOSO will complete the relevant sections of this form and forward to the PM for completion. The report will then be provided to the MMG-TLI JV HSD before the end of the following shift.

If any employee of a subcontractor is injured, documentation of the incident will be accomplished IAW the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the UXOSO within 24 hours after the accident has occurred.

Any OSHA-reportable injury (i.e. all work-related fatalities must be reported within eight hours of the incident, and all work-related inpatient hospitalizations, amputations, or losses of an eye must be reported within 24 hours) requires immediate accident notification to the Contracting Officer (CO)/(COR) and the HSD. All recordable injuries will be documented on an *Injury and Illness Incident Report Form* (OSHA Form 301) and USACE Form 3394 (copies of which are provided in Tab C) and any additionally required USACE internal reporting forms.

10.1.6 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, require notification to the USACE PM and OESS, and will be reported according to the sequence identified in the *Site-Specific Spill Reporting Card*. Spill reporting must also follow LHAAP's spill reporting and clean-up requirements IAW the Hazardous Waste Permit Contingency Plan. In determining whether a spill or release must be reported to a regulatory agency, the SUXOS or UXOSO will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, the applicable regulatory permit, and/or client-specific reporting procedures. In order to support the SUXOS and expedite the decision to report to a state regulatory agency, a site-specific Spill Reporting Card will be developed. **If reporting to a State or Federal regulatory agency is required, MMG-TLI JV has 15 minutes from the time of the spill/release to report to LHAAP who will then report to the appropriate agency.**

Chemical-specific CERCLA Reportable Quantities are available at the following website:

http://www.ecfr.gov/cgi-bin/text-idx?SID=b1137f024f2a28db2211406e1cef2442&mc=true&node=pt40.28.302&rgn=div5.

10.1.7 Posting of Emergency Numbers

Emergency contact information will be posted on a bulletin board in the site office trailer. A copy of Table 10-2 Emergency Contacts, will also be kept in the gloveboxes of all field vehicles, along with the most current version of Table 10-1 Emergency Planning and a copy of Figure 10-1: Hospital Route/Detail Map.

Table 10-3: Emergency Contacts

Emergency Coordinators/Key Personnel			
Name	**Title/Workstation**	**Telephone Number**	**Mobile Phone**
Aaron Williams	USACE Technical Manager	(918) 669-4915	
Dennis Myers	USACE Lead OESS	(720) 670-0493	
Scott Beesinger	LHAAP POC	(903) 679-3448	
Don Jenkins	Program Manager	(865) 686-8972	(865) 742-6971
Kyra Donnell	Project Manager	(303) 887-0786	(865) 607-0502
Brian Gentry	MTL	(865) 206-6290	(706) 992-6064
Ray Fillion	SUXOS		(480) 280-6004
Robert L. Miller	UXOSO		(903)-227-9954
Erika Erikson	HSD	(703) 8181-3222	(571) 386-7304

Organization / Agency	
Name	**Telephone Number**
FIRST CONTACT FOR ANY EMERGENCY SITUATION LHAAP Base Operations Center	911
Police Department	911
Fire Department	911
Ambulance Service	911
Hospital: CHRISTUS Good Shepherd Medical Center - Marshall **Address:** 811 S Washington Ave, Marshall, TX 75670 **Approximate time to drive:** 28 minutes (Hospital Route Maps on following page) Hospital Route: See Figure 10-1 below	(903) 927-6000
Poison Control Center	(800) 222-1222
Pollution Emergency	(800) 292-4706

National Spill Response Center	(800) 424-8802
Chem-Tel	(800) 424-9300
Title 3 Hotline	(800) 535-0202
Federal OSHA Hot Line	(800) 321-6742
Public Utilities	
Name	**Telephone Number**
LHAAP will coordinate utility markings and signatures	N/A
Call Before You Dig	811

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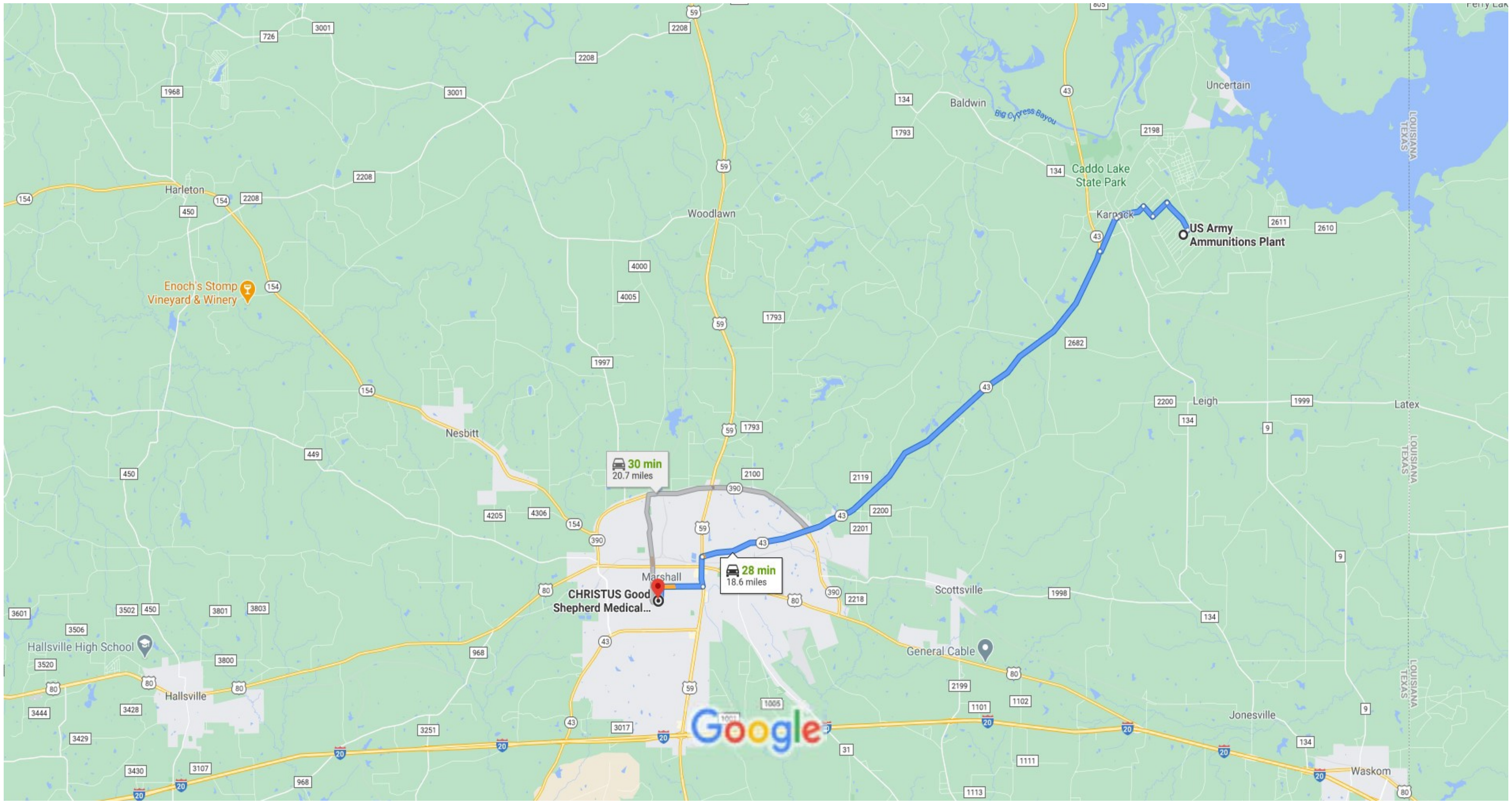
Figure 10-1: Hospital Route/Detail Map

Take Avenue N, Zeugner Dr and TX-449 Spur S to TX-43 S. **Follow** TX-43 S to E Travis St in Marshall**. Turn left** on TX-43 S**. Use any lane to turn left** onto E End Blvd N**. Continue** on E Travis St to your destination. **Turn right** onto E Travis St. **Turn left** onto S Washington Ave. **Turn right** onto University Ave. **Turn right** and destination will be on your right.



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10.2 INCLEMENT WEATHER

In the event of inclement weather, electrical storms, or extremely cold weather it may be necessary to cease operations and take cover or evacuate the site. The UXOSO will be responsible for listening to a National Weather Service (NWS) weather radio on a daily basis or more frequently if necessary.

In the event of adverse weather, the UXOSO will determine if work can continue without endangering the health and safety of site personnel. Some of the items to be considered prior to determining if work should continue are the following:

- Heavy rainfall
- Potential for heat stress
- Potential for cold stress
- Tornadoes
- High wind
- Limited visibility
- Electrical storms
- Potential for accidents
- The malfunctioning of monitoring equipment

Severe weather with thunderstorms, associated lightning, high wind, and possible tornadoes are features of the region. Therefore, meteorological conditions will be closely watched. Thunderstorms and tornadoes often occur late in the afternoon on hot days, but they can occur at any time of the day and in any season of the year. Tornadoes are usually preceded by severe thunderstorms with frequent lightning, heavy rains, and strong winds. Arroyos and gullies on-site are subject to flash flooding and should be avoided during and after periods of heavy rain.

A severe thunderstorm or tornado watch announcement on the radio or television indicates that a severe thunderstorm or tornado is possible. Additionally, LHAAP has a comprehensive weather warning system that is active 24/7, complete with a base-wide siren system, which will sound in the event of a weather emergency. Work will continue at the work site during the watches. A severe thunderstorm or tornado warning signifies that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All on-site work will cease during a thunderstorm, severe thunderstorm warning, tornado warning, or by activation of the base-wide siren system.

Personnel on-site during a tornado will take the following steps:

- Evacuate vehicles;
- If possible, seek shelter in the LHAAP Tornado Shelters;
- If outdoors, lie flat on the ground (in a ditch or other depression, if possible);
- Stay away from power poles, electrical appliances, and metal objects; and
- Do not try to outrun a tornado.

Personnel on-site during a thunder/lightning storm will take the following steps:

- Once lightning is seen, count the number of seconds until you hear the thunder. Divide the number of seconds by 5 to get the distance the lightning is away from you. If lightning is 10 miles away or less, work should stop until 30 minutes after the last audible thunder or visible flash of lightning. Safe shelter sites include: fully enclosed, all-metal vehicles and permanent, substantial buildings.
- Do not stand in or near windows, open doors, and fire places.

- Use cellular phones and avoid land phones.
- Do not use showers.
- If a safe building or vehicle is not nearby, site personnel should find a low, dry spot away from trees, fences, arroyos, bodies of water, or metal objects. To avoid being the tallest object and to minimize contact with the ground, site personnel shall crouch on the balls of their feet and wrap their arms around their knees while lowering their head between their knees.
- Never seek shelter under a single tree.

All site personnel shall remain in their respective safe areas for approximately 30 minutes after seeing the last flash of lightning and/or they are given notice by the UXOSO that work may commence.

PERSONNEL ACKNOWLEDGEMENT

By signing below, the undersigned acknowledges that he/she has read and reviewed the MMG-TLI JV Health and Safety Plan for the LHAAP site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work and will comply with the provisions contained therein.

PRINT NAME	**SIGNATURE**	**ORGANIZATION**	**DATE**

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Tab A

Activity Hazard Analysis

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Table A-1 Proposed Activity and Associated Hazards

Activity	Chemical Hazards			Biological Hazards		Physical Hazards					Explosive Hazards
	Chemical Exposure	Respiratory Exposure	Confined Space	Animals	Plants	Slip/Trip/Fall	Ergonomic	Crush	Noise	Impacts or Cuts	
AHA-1: Mobilization/Demobilization	L	L	NA	L	L	L	M	M	M	L	L
AHA-2: General Site-Wide Hazards	M	M	NA	L	L	L	M	M	M	M	NA
AHA-3: Visual Surface Clearance	M	M	NA	L	L	L	M	M	M	M	M
AHA-4: Vegetation Removal	M	M	NA	L	L	M	M	M	M	M	M
* AECOM AHA-5: DGM	M	M	NA	L	L	M	L	M	M	M	M
AHA-6: Reacquisition and Intrusive Removal of Anomalies	M	M	NA	L	L	M	M	M	M	L	M
AHA-7: Excavation with EMM	M	M	NA	L	L	L	M	M	M	M	M
AHA-8: MEC Disposal Operations	M	M	NA	L	L	L	M	M	M	M	M
AHA-9: MPPEH Processing	M	M	NA	L	L	L	M	M	M	M	M
AHA-10: RDW	M	M	NA	L	L	L	M	M	M	M	M
AHA-11: Soil Sampling	M	L	NA	L	L	L	L	M	L	M	NA
AHA-12: Equipment Decontamination	L	L	NA	L	L	M	L	L	M	M	M
AHA-13: Site Restoration	L	L	NA	L	L	L	L	L	M	M	NA

Table A-1 Proposed Activity and Associated Hazards (Continued from previous page)

Activity	Chemical Hazards			Biological Hazards		Physical Hazards					Explosive Hazards
	Chemical Exposure	Respiratory Exposure	Confined Space	Animals	Plants	Slip/Trip/Fall	Ergonomic	Crush	Noise	Impacts or Cuts	
AHA-14: Coronavirus Disease Pandemic	N/A	M	NA	NA	NA	NA	NA	NA	NA	NA	NA
*Bhate AHA-01: General Site Activities											
*Bhate AHA-02: Groundwater sampling											
*Bhate AHA-03: Operation and Maintenance of Groundwater Treatment Plant (GWTP)											
* Bhate AHA-04: Management of Investigative Derived Waste (IDW)											
* Bhate AHA-05: Soil sampling and boring abandonment											
* Bhate AHA-06: Monitoring Well Installation											
* Bhate AHA-07: Excavation/Backfill/Site Restoration											
* RFI AHA: Mobilization/Demobilization											
* RFI AHA: Cutting and Welding											
* RFI AHA: Robotic Vegetation Removal											
* RFI AHA: Robotic Heavy Equipment Operations											
* RFI AHA: Robotic Screening Operations											

Activity	Chemical Hazards			Biological Hazards		Physical Hazards					Explosive Hazards
	Chemical Exposure	Respiratory Exposure	Confined Space	Animals	Plants	Slip/Trip/Fall	Ergonomic	Crush	Noise	Impacts or Cuts	

* - AHAs provided by Subcontractors

L Low Hazard Potential—PPE or administrative controls may not be required
M Moderate Hazard Potential—Minimal PPE or administrative controls required for protection
H High Hazard Potential—Proper PPE or administrative controls must be used to protect from hazard
NA Not Applicable

Table A-2 Risk Assessment Code Matrix

Risk Assessment Code (RAC) Matrix					
Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L
Step 1: Review each “Hazard” with identified safety “Controls.” Determine RAC (see above)					

Probability: Likelihood the activity will cause a Mishap (near miss, incident or accident). Identify as Frequent, Likely, Occasional, Seldom, or Unlikely.	RAC Chart
Severity: The outcome if a mishap occurred. Identify as Catastrophic, Critical, Marginal, or Negligible	E = Extremely High Risk H = High Risk
Step 2: Identify the RAC (probability vs. severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.	M = Moderate Risk L = Low Risk

AHA-1: Mobilization/Demobilization	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: Mobilize/demobilize equipment and personnel to the site		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Mobilize/demobilize equipment and personnel	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Establish temporary storage area for equipment • Secure materials in storage • Perform underground utility clearance • Layout decontamination area • Pack up equipment	• Fire - equipment fueling	• All motors must be shut off during refueling. Do not fuel hot equipment. • Smoking in the vicinity of fueling operations is not permitted. • An ABC fire extinguisher must be maintained on all heavy equipment. • Fuel containers will not be stored within 10 feet of the heavy equipment. • Fuel will be stored in Underwriter Laboratory (UL)-approved safety containers with contents clearly labeled. • Fueling area will be maintained free of vegetation and debris with proper signage. • Fuel spill containment kit will be available.	L
	• Entry of unauthorized personnel	• Establish positive site access control prior to conducting any on-site operations using barricades, signs, or other methods. • Site personnel will maintain a constant watch for intrusion of unauthorized personnel. • Report unauthorized personnel found in the work site to Project Manager and SSHO.	L
	• Electrical injury	• No intrusive work will be performed proximal to buried utilities. • Inspect for buried and overhead utilities near all work locations. Utility locates must be completed within 2 months prior to intrusive work.	L
	• Hand injury	• Use leather work gloves for material handling. • Check that loads to be handled are free of sharp edges, metal slivers, burrs, and rough or slippery surfaces. • Keep hands, fingers and feet clear of moving/suspended materials and equipment. • Beware of contact/pinch points. • Use mechanical drum handlers • Keep feet and hands clear of areas between pieces of equipment.	L
	• Hand tools	• Hand tools will be selected so that the right tool is being used for the right job and being used in the manner in which it was intended to be used. • Hand tools will be inspected daily prior to use and any defective tools will be tagged and removed from service immediately.	L
	• Portable electric tools	• Portable electric tools that are unsafe due to faulty plugs, damaged cords, or other reasons, shall be tagged (e.g., “do not use”) and removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a Ground Fault Circuit Interrupter (GFCI) device. • Tools shall be inspected daily prior to use. • Tools shall be used only for their intended purpose. • Verify that guards are in place.	L

AHA-1: Mobilization/Demobilization	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: Mobilize/demobilize equipment and personnel to the site		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		• Wear American National Standards Institute (ANSI)-approved safety glasses. In addition to safety glasses, wear face protection for electric or pneumatic grinding, chipping, abrasive saw metal cutting, chain saw, and brush cutter work. • Do not use electrical power tools in wet environments. • Where a tool is necessary on a continuous or repetitive basis, frequent rest breaks will be taken. • Heavy tools will not be used above the level of the shoulder.	
• Loading/unloading of equipment	• Mechanical equipment	• Only qualified personnel shall be permitted to operate equipment. • Mechanical equipment shall be inspected daily. Deficiencies in equipment shall be noted on the inspection form. Equipment found to be unsafe shall not be used. • All equipment shall be operated at safe speeds and in a safe manner. • Equipment operators shall wear safety belts, and hearing protection when required. • Use alarm or spotter when reversing heavy equipment. • Ground personnel shall not position themselves between equipment and stationary objects. • Personnel are only permitted to approach equipment after a signal from the operator. • Stay one or two rollover distances away and 1 1/2 equipment lengths away from end.	L
	• Heavy lifting, back strain, overexertion	• Use the best ergonomically designed equipment. • Avoid twisting/turning while pulling on tools and when moving equipment. • Use mechanical lifting devices whenever possible. • When mechanical lifting devices are not available, use a two-person lift. • Lifts greater than 40 pounds require assistance or mechanical equipment. • Use proper lifting techniques. • Carry heavy loads using two hands. • Never carry a load that cannot be seen around or over. • Observe/evaluate the size, shape, and weight of the object to be lifted. • Clear your path of travel before lifting. • Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear. • Fingers must be kept away from points that could crush or pinch them, especially when putting an object down. • Gloves must be used, and the object must be inspected for metal slivers, jagged edges, burrs, rough, or slippery surfaces. • The hands and the object should be free of dirt or grease that could prevent a firm grip.	M
Equipment Used	**Inspection Requirements**	**Training Requirement**	

AHA-1: Mobilization/Demobilization	**Overall Risk Assessment Code (RAC): M**	Date: November 2020
		Project: Longhorn Army Ammunition Plant
Description of Activity: Mobilize/demobilize equipment and personnel to the site		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Motor vehicles • Power Tools • Hand Tools • Fuel spill containment kit • Fire extinguisher • Portable eye wash bottles	• Inspect cord on power tools for frayed wires and loose connections. • Inspect hand tools for excessive wear and loose parts. • Inspect fire extinguishers and portable eyewash bottles. • Inspect spill kits.	Personnel must have: • Current driver's license; • Occupational Safety and Health Administration (OSHA) qualifications and training as required in accordance with the Quality Assurance Project Plan (QAPP)/Site Safety and Health Plan (SSHP); • Site orientation training; and • Hazard Communication Program training.	

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• General Site-Wide Activities	• Ingress to/egress from site	• Utilize good housekeeping practices. • Keep aisle ways, pathways, and work areas free of obstruction. • Clean ice or snow off of walkways. • Use appropriate footwear for the task assigned. • Potentially hazardous work areas will be properly signed and taped-off. Access will be restricted.	L
	• Office hazards: - Fire Hazards - Trips, Falls and Collisions - Office equipment hazards	• Ensure multi-plug extension leads have circuit breakers or install more sockets. Do not overload electrical sockets • Ensure you switch off or unplug all electrical equipment not in use. • Replace damaged power cables. • Know the locations of fire extinguishers and how they function. • Familiarize yourself with evacuation routes • Ensure all dangling telephone wires and other cables are housed in cable protectors or tie up and/or secure cords so they don’t pose a trip hazard. • Keep all walkways and hallways clear • Cleanup any spillage as they occur. • When it’s slippery due to ice and snow, walk like a penguin when entering and leaving your office. • Do not stand on desks or chairs. Always use a stepladder or stool. • Remove all defective furniture (e.g., missing casters, screws missing from areas of chairs). • Don’t lean back in chairs on two legs. • Walk around corners slowly. • Avoid injuring fingers by closing all filing cabinet drawers with the handle. • Avoid top loading. Balance all file loads evenly through cabinet drawers. • Do not leave filing cabinet drawers open and unattended. • Avoid the risk of injury when reaching into a desk drawer by keeping sharp object such as knives, scissors and pins in a separate container.	L
	• Unfamiliarity with: site, general (chemical, physical, environmental) site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• All personnel shall attend the site orientation training. The site orientation shall include a review of the phone locations, evacuation routes, and any special requests from the facility, U.S. Army Corps of Engineers (USACE), and MMG-TLI Joint Venture (MMG-TLI JV). Training: All AHAs shall be reviewed with personnel.	L
	• Unattended worker	• All crew personnel at the work site must use the "buddy system" (working in pairs or teams). • Always have a means of communication (e.g., radio, cell phone).	L
	• Slips, trips, and falls	• Avoid placing any supplies in immediate high-traffic areas. • Continually inspect the work area for slip, trip, and fall hazards including animal burrows. • Use caution when walking on rocky, slippery, or uneven terrain. • Determine best access route before transporting equipment. • Flag or cover inconspicuous holes to protect against falls.	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		• Look before you step; maintain safe and secure footing. • Personnel are not allowed to work off machinery or use them as ladders. • Practice good housekeeping; keep work area picked up and clean. • Provide adequate lighting in all work areas to aid in the identification of hazards. • Tools and accessories will be properly maintained and stored. • Use fall protection when working above 6 feet or when exposed to a fall of 6 feet or greater. • Whenever possible, avoid routing cords and hoses across walking pathways. If unavoidable, the trip hazard shall be posted to alert all workers. • Work areas will be kept free of dirt, grease, and slippery materials. • Wear high-traction footwear.	
	• Fire	• Smoking or open flames are prohibited except in designated smoking areas. • Designated smoking areas are to be free of combustibles and will have a 5-gallon metal bucket of sand and a fire extinguisher. • Vehicles/equipment will not be left unattended while idling. • Power equipment/vehicles will travel and park on pavement whenever possible. • Contact **9-1-1** in the event of a fire or explosion. • Fire extinguishers will be available in the field vehicles. • Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition. • Mechanized equipment shall be shut down prior to and during fueling operations. • Only approved safety containers shall be used for handling and storage of flammable material. • Storage cans for flammable materials shall not be stored in direct sunlight. • The hazard communication requirements apply to the use of flammables and combustibles. • Refueling areas will be located at least 25 feet from other operations. • Spill containment, collection, and clean-up materials will be provided in refueling areas. • Transfer containers will be electrically bonded together. • All spark-producing equipment in the immediate vicinity of flammable liquid dispensing operations will be shut down. Adequate cool down time for generators, pumps, and other portable equipment will be provided prior to refueling. • Pressure buildup in portable fuel cans will be relieved away from hot surfaces and spark producing equipment. • Dispensing nozzles will have an automatic shut-off and no "latch open" devices. • Disconnect switches for refueling equipment will be located away from refueling operations.	L
	• Chemical/contaminant exposure	• Visual contact shall be maintained between crew members at all times, and crew members must observe each other for signs of toxic exposure. Indications of adverse effects include, but are not limited to: changes in complexion and skin coloration, changes in coordination, changes in demeanor, excessive salivation and papillary response, and/or changes in speech pattern.	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		• All personnel will attend all hazard communication training and follow safe work practices when working in potential contamination areas. • Personnel shall immediately notify the Site Safety and Health Officer (SSHO) if odors are detected. • Label all containers as to contents and dispose of properly. • Verify that a Safety Data Sheet (SDS) is available for each hazardous chemical used on-site. • SDSs shall be obtained and approved prior to chemicals being brought on-site.	
	• Noise hazard	• Use hearing protection when exposed to excessive noise levels (greater than 85 decibels (dBA) over an 8-hour work period). • Assess noise level with sound level meter if possibility exists that level may exceed 85 dBA time-weighted average (TWA). • If protective equipment or noise levels impair communications, then prearranged hand signals shall be used for communication.	L
	• Cuts and abrasion hazards	• Use cotton or leather work gloves for material handling. • Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, rough, or slippery surfaces. • Ensure loads to be handled are free of sharp edges, metal slivers, burrs, and rough or slippery surfaces.	L
	• Heavy lifting, back strain, overexertion	• Use best ergonomically designed equipment. • Avoid twisting/turning while pulling on tools and when moving equipment. • Use mechanical lifting devices whenever possible. • When mechanical lifting devices are not available, use two-person lift. • Lifts greater than 40 pounds require assistance or mechanical equipment. • Use proper lifting techniques. • Carry heavy loads using two hands. • Never carry a load that cannot be seen around or over. • Observe/evaluate the size, shape, and weight of the object to be lifted. • Clear your path of travel before lifting. • Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear. • Fingers must be kept away from points that could crush or pinch them, especially when putting an object down. • The hands and the object should be free of dirt or grease that could prevent a firm grip.	M
	• Ultra Violet (UV) radiation (sunburn)	• Wear long-sleeved shirts, hats, and sunscreen. • Symptoms of overexposure include: o Red skin that may hurt when touched; o Blistering, which may occur with a more severe burn; and o Sun poisoning, which may result in fever, chills, nausea, vomiting, or headache. • Home remedies may be used in most cases.	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
	• Cold Stress	• Workers should wear insulated clothing when temperatures drop below 40° F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • During operations in wet areas, waterproof boots are recommended. Change socks regularly to keep feet dry. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing. • The signs of cold stress disorders are given below: - Hypothermia can be a serious medical condition. Symptoms include: o Confusion o Dizziness. o Exhaustion o Severe shivering - Frostbite can be a serious medical condition. Symptoms include: o Gray, white, or yellow skin discoloration o Numbness o Waxy feeling skin • If someone exhibits signs of hypothermia or frostbite, get them out of wet clothes immediately and warm the core body temperature with a blanket or warm fluid like hot cider or soup if the individual is conscious. Do not administer caffeine or alcohol. Call **9-1-1** if necessary.	L
	• Heat Stress	• Wear light colored clothing. • Observe work/rest cycles and take frequent breaks. • Evaluate the possibility of working at night or starting work earlier in the day as temperatures are generally cooler during the night and early morning. • Conduct physiological (heart rate, oral temperature) or wet-bulb globe temperature (WBGT) monitoring as indicated. • Pre-hydrate and stay hydrated throughout the work shift. • Have ice packs available for use. **Symptoms of heat stress include:** • **Heat rash**. Symptoms include: Muscle spasms; pain in hands, feet, and abdomen; red or pink dots on the body under areas covered by clothing. - Keep the skin clean and dry. - Change perspiration-soaked clothing, as necessary. - Bathe at end of work shift or day. - Apply powder to affected area.	l

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	Potential Hazards	Recommended Hazard Controls	RAC
		- Drink plenty of cool fluids, even when not thirsty, including water and sports drinks. - Provide cool fluids for work crews. Move victim to rest in shaded, cool area and a comfortable position. If the person is fully awake and alert, give a half glass of cool water every 15 minutes. Do not let him or her drink too quickly. Do not give liquids with alcohol or caffeine in them, as they can make conditions worse. Remove or loosen tight clothing and apply cool, wet cloths such as towels or wet sheets. Call 9-1-1 if the person refuses water, vomits, or loses consciousness. • **Heat exhaustion**. Symptoms include: Pale, cool, moist skin; heavy sweating; dizziness; nausea; and fainting. If someone exhibits signs of heat exhaustion, get the person to a cool area and a comfortable position. If the person is fully awake and alert, give a half glass of cool water every 15 minutes. Do not let him or her drink too quickly. Do not give liquids with alcohol or caffeine in them, as can make conditions worse. Remove or loosen tight clothing and apply cool, wet cloths such as towels or wet sheets. Call 9-1-1 if the person refuses water, vomits, or loses consciousness. • **Heat stroke.** Symptoms include red, hot, unusually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma. - If someone exhibits signs of heat stroke, help is needed fast. - **Call 9-1-1.** - Move the person to a cooler place. Quickly cool the body. Wrap wet sheets around the body and fan it. If you have ice packs or cold packs, wrap them in a cloth and place them on each of the victim's wrists and ankles, in the armpits, and on the neck to cool the large blood vessels. Do not use rubbing alcohol because it closes the skin's pores and prevents heat loss. Watch for signals of breathing problems and make sure the airway is clear. Keep the person lying down.	
	• Severe weather	• The SSHO will monitor weather conditions each day in order to plan and prepare for hazardous conditions. • The SSHO will identify a suitable shelter at each work location. • Work activities will be suspended prior to weather conditions becoming hazardous to allow workers ample time to seek shelter.	L
	• Lightning	• Halt activities and take cover. • If lightning is observed within 10 miles, take shelter immediately. • Seek shelter in a building or vehicle, if possible. • If outdoors, stay low to the ground. • If available, crouch under a group of trees instead of one single tree. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than lying on the ground). • If indoors, stay away from windows.	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	Potential Hazards	Recommended Hazard Controls	RAC
	• Thunderstorms, floodwaters, tornadoes	• Listen to radio or television announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado. • If you encounter floodwaters, do not try to cross them. Avoid them, and go to higher ground.	L
	• Vehicle operations	• Only licensed drivers will operate vehicles. Site vehicles will be equipped with a first aid kit, fire extinguisher, and an emergency contact list. • Walk around the vehicle before moving or backing up. • Check that items placed in vehicle are secured. • Wear seat belts when traveling. • Follow safe driving practices. • When vehicle is in motion, cell phone use is authorized only if using a hands-free device. • Obey all traffic laws; yield to oncoming traffic and pedestrians.	L
	• Wildlife, snakes, insects, ticks	• Avoid storing food stuff where accessible to animals. Seal food in air tight containers when possible. • Do not feed wildlife. • Avoid placing hands or feet into obscure areas (i.e., beneath rocks, well pads, brush piles). • Wear insect repellant (permethrin and DEET). • If a snake bite occurs: - Victim should be immediately transferred to nearest hospital; - First-aid-trained personnel may apply pressure to bandage; and - Identify infested areas to the SSHO. • Keep work areas clear of vegetation and small brush. • Tape pant legs and sleeves if entering areas of dense vegetation. • Use the buddy system. • When walking through overgrown grass areas, watch for snakes. • Wear snake chaps in areas possibly inhabited by poisonous snakes or animals. • Workers who are allergic or capable of allergic reactions to bee, wasp, or ant stings or bites shall notify their supervisor(s). • Evaluate need for sensitive workers to have prescribed antibiotic or medicine to combat onset of symptoms. • Personnel bitten by snakes that are allergic to horses should notify emergency personnel of their allergy. • Wear light-colored clothing (ticks are more visible). • Wear long sleeves and long pants. Tape pant legs and sleeves if entering areas of dense vegetation. • Visually check oneself promptly and frequently after exiting the work area. • If you find a tick on your body, remove it by doing the following:	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		- Using a pair of fine-tipped tweezers, grasp the tick as close to the skin as possible and pull slowly, steadily, and firmly; and - Avoid crushing the tick's body. • Once removed, clean the area with antiseptic, such as alcohol. Wash hands with soap and water. • Save the tick so it can be identified by the local health department.	
	• Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.	L
	• Poor sanitation	• An adequate supply of potable water will be provided at each work site. • Potable water may be supplied in individual bottles (≤ 1 liter) or larger, portable containers. • Portable containers used to dispense drinking water shall be capable of being tightly closed and shall be equipped with a tap dispenser. Water shall not be drunk directly from the container. • Containers used for drinking water shall be clearly marked "potable water" and not used for any other purpose. • Disposable cups will be supplied; both a sanitary container for unused cups and a receptacle for disposing of used cups shall be provided. • Outlets for non-potable water shall be identified to clearly indicate that the water is unsafe and is not to be used for drinking, washing, or cooking purposes. There shall be no cross connection (open or potential) between potable and non-potable water systems. Non-potable and potable water systems shall be separated so as to minimize confusion and possible cross contamination. • An adequate number of toilet facilities shall be available for employees. If permanent toilet facilities are not available (i.e., the work site is more than 500 feet from a building with an accessible toilet), and mobile crews do not have access to a vehicle, then portable chemical toilet(s) will be provided. • Trash collected from the work site will be segregated into potential hazardous waste or construction debris. Labeled trash receptacles will be set up in the contaminant reduction zone (CRZ). • At no time should shall any environmental samples be placed in the same refrigerator that is used for food and beverages. Environmental samples shall be placed in chilled coolers or in a separate labeled refrigerator.	L
	• Traffic	• Place physical barrier (i.e., barricades, fencing) around work areas regularly occupied by pedestrians. • If working adjacent to roadways, workers will wear fluorescent vests with reflective stripes. • Use warning signs or lights to alert oncoming traffic. • Assign flag person(s) if necessary to direct local traffic. • Set up temporary parking locations outside the immediate work area. • Motor vehicle operators shall obey all posted traffic signs, signals, and speed limits.	L

AHA-2: General Site-Wide Hazards	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: General Site-Wide Hazards		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		• Pedestrians have the right-of-way. • Wear seat belts when vehicles are in motion.	
Equipment Used	**Inspection Requirements**	**Training Requirement**	
Equipment specific for tasks are listed on the task-specific AHA	Not Applicable	Personnel must have: • 40-hour Hazardous Waste Operator (HAZWOPER) with current 8-hour refresher and site-specific hazard communication training; • Training in the safe use of specific equipment and in personal protective equipment required to perform their job; and • Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW), and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities," most current version.	

AHA-3: Visual Surface Clearance	**Overall Risk Assessment Code (RAC): M**	Date: November 2020
		Project: Longhorn Army Ammunition Plant
Description of Activity: Clearing the ground surface of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH)/Munitions Debris (MD)/Range Related Debris (RRD)		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Conduct visual surface clearance	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Mobilize	• Unfamiliarity with site, site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• Read and follow the Quality Assurance Project Plan (QAPP)/Accident Prevention Plan (APP) and U.S. Army Corps of Engineers (USACE) Safety Concepts for Munitions and Explosives of Concern (MEC) operations. • Check field vehicle for necessary vehicle equipment (i.e., ice scrapers, fire extinguishers, first aid kits, etc.) and road safety kit. Also check field vehicle tire conditions and lights. • Verify that Emergency Medical Services (EMS) are available and can respond in a prompt manner prior to the start of work. • Ensure Base or local EMS and Fire Dispatch numbers programmed into cell phones. • Ensure hospital route maps readily available. • Buddy system must be maintained for all phases of work. • Report all unsafe conditions and acts, injury/illness, or property damage to supervisors immediately. • Contact the Site Safety and Health Officer (SSHO) immediately for any work-related incidents and near misses. • All employees have the right and responsibility to stop work for any unsafe conditions that cannot be immediately corrected. Contact the SSHO immediately upon stoppage. • All personnel must have current Occupational Safety and Health Administration (OSHA) certifications. • All personnel must be aware of the Personal Protective Equipment (PPE) requirements (Level D).	L
• Evacuation of non-essential personnel	• Unplanned detonation	• Evacuate all non-essential personnel to outside the designated exclusion zone (EZ) as specified in the Department of Defense Explosives Safety Board (DDESB) approved Explosives Safety Submission (ESS). • Use these personnel as road guards to ensure unauthorized visitors do not enter the EZ.	L
• Conduct visual surface clearance	• Back injuries	• Use proper lifting techniques and use a buddy for heavier lifts.	L
	• Lacerations	• Wear leather gloves when handling MEC/MD. • Items to be handled shall be inspected for sharp edges prior to being handled. • Personnel shall be aware of and avoid pinch point hazard.	L

Equipment Used	Inspection Requirements	Training Requirement
• Communications Equipment	• Daily communication checks	Personnel must have, practice, and ensure: • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Techniques for MEC/Unexploded Ordnance (UXO) avoidance; • Safe work practices and precautions associated with task being performed in accordance with the QAPP; • Specific response training in accordance with the QAPP/Site Safety and Health Plan (SSHP); • Evacuation and emergency procedures in accordance with the ERP/SSHP; • UXO identification and safety precautions for UXO personnel in accordance with the QAPP/SSHP; • OSHA qualifications and training as required in accordance with the QAPP/SSHP; and • Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW), and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities", most current version.

AHA-4: Vegetation Removal	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: Removal of grasses, underbrush, trees less than 6-inches in diameter at chest height, and understory, using manual and mechanical means.		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	Potential Hazards	Recommended Hazard Controls	RAC
• Mobilize to site • Conduct vegetation removal	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Mobilize	• Unfamiliarity with site, site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• Read and follow the Quality Assurance Project Plan (QAPP)/Accident Prevention Plan (APP) and U.S. Army Corps of Engineers (USACE) Safety Concepts for Munitions and Explosives of Concern (MEC) operations. • Check field vehicle for necessary vehicle equipment (i.e., ice scrapers, fire extinguishers, first aid kits, etc.) and road safety kit. Also check field vehicle tire conditions and lights. • Verify that Emergency Medical Services (EMS) are available and can respond in a prompt manner prior to the start of work. • Ensure Base or local EMS and Fire Dispatch numbers are programmed into cellular phones. • Ensure hospital route maps readily available. • Ensure buddy system is maintained for all phases of work. • Report all unsafe conditions and acts, injury/illness, or property damage to supervisors immediately. • Contact SSHO immediately for any work-related incidents and near misses. • All employees have the right and responsibility to stop work for any unsafe conditions that cannot be immediately corrected. Contact SSHO immediately upon stoppage. • Ensure all personnel's Occupational Safety and Health Administration (OSHA) certifications are current. • All personnel must be aware of the Personal Protective Equipment (PPE) requirements (Level D).	L
• MEC avoidance - escort vegetation crews	• Surface MEC	• Unexploded Ordnance (UXO) escort will search for surface MEC hazards.	M
• Manual vegetation removal (handsaws, machete, etc.)	• Hazards associated with swinging sharp tools	• Ensure swing area is clear of co-workers. • Wear leather gloves. • Wear safety glasses, goggles, and face shields as appropriate.	L
	• Heavy lifting, strains, and sprains.	• No individual employee is permitted to lift any object that weighs over 40 pounds. • Proper lifting techniques shall be used. • Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 40-pound limit.	M
	• Hand injuries.	• Items to be handled shall be inspected for sharp edges prior to being handled. • Personnel shall wear leather gloves when handling sharp materials. • Personnel shall be aware of and avoid pinch point hazards.	L
• Mechanical vegetation removal (mowers, , etc.)	• Injuries resulting from operation of mechanical equipment • Lacerations • Flying debris, dust	• Stay clear of operators. • Ensure shields/guards are in place. • Personnel shall be familiar with cutting techniques. • Wear safety glasses, goggles, and face shields as appropriate.	L
	• Noise Exposure	• Wear hearing protection.	L
	• Fatigue	• Equipment operators shall be given ample rest breaks to avoid injury due to fatigue.	L

Equipment Used	Inspection Requirements	Training Requirement
• Hand Tools, non-powered • Communications Equipment • Handsaws, machetes • Mowers • Hearing protection, leather gloves, safety glasses, goggles, and face shields	• Construction equipment safety inspection • Daily communications checks • Inspect in accordance with manufacturer's recommendations	Personnel must have, practice, and ensure: • Equipment Operator familiarity with equipment; • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Techniques for MEC/UXO avoidance; • Safe work practices and precautions associated with task being performed in accordance with the QAPP/Site Safety and Health Plan (SSHP); • Evacuation and emergency procedures are conducted in accordance with the ERP/SSHP; • UXO identification and safety precautions for UXO personnel are conducted in accordance with the QAPP/SSHP; • OSHA qualifications and training as required in accordance with the QAPP/SSHP; and • Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW) and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities," most current version.

AHA-5: Digital Geophysical Mapping (DGM)	**Overall Risk Assessment Code (RAC): M**	Date: November 2020
		Project: Longhorn Army Ammunition Plant
Description of Activity: Performing DGM across open grounds using EM61 or EM31 man-portable equipment.		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	Potential Hazards	Recommended Hazard Controls	RAC
• Mobilize to Site • Conduct Geophysical Survey	• General site-wide hazards	• Review general site-wide AHA for identified hazards and controls for various site-wide hazards.	M
• Mobilize to Site	• Unfamiliarity with site, site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• Read and follow the Quality Assurance Project Plan (QAPP)/Accident Prevention Plan (APP) and U.S. Army Corps of Engineers (USACE) Safety Concepts for Munitions and Explosives of Concern (MEC) operations. • Check field vehicle for necessary vehicle equipment (i.e., ice scrapers, fire extinguishers, first aid kits, etc.) and road safety kit. Also check field vehicle tire conditions and lights. • Verify that Emergency Medical Services (EMS) are available and can respond in a prompt manner prior to the start of work. • Ensure Base or local EMS and Fire Dispatch numbers are programmed into cellular phones. • Ensure hospital route maps readily available. • Ensure buddy system is maintained for all phases of work. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Contact SSHO immediately for any work-related incidents and near misses. • All employees have the right and responsibility to stop work for any unsafe conditions that cannot be immediately corrected. Contact SSHO immediately upon stoppage. • All personnel's Occupational Safety and Health Administration (OSHA) certifications must be current. • All personnel must be aware of the Personal Protective Equipment (PPE) requirements (Level D).	L
	• Driving	• Always using a seat belt while driving on military/government facilities. • Always observe posted speed limits, traffic signs, and signals. • Never use a cell phone (including hands-free devices) or two-way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Precautions will be taken to avoid driving in inclement weather, however if conditions worsen while already on the road, safe inclement driving practices will be followed; such as slowing down, driving with hazard lights on, and if need be, stopping for the night. • Personnel mobilizing to the site will be well-rested and no personnel will drive if tired.	L
• Conduct Geophysical Survey	• Heavy lifting	• Plan storage and staging to minimize lifting or carrying distances. • Ensure that the path of travel is clear prior to lifting/carrying. • Avoid carrying heavy objects above shoulder level.	L
	• Poor lighting	• Perform tasks in daylight hours only.	L
	• MEC	• Where MEC is potentially present, Unexploded Ordnance (UXO)-trained personnel will escort non-UXO personnel at all times. • In the event a potential MEC/material potentially presenting an explosive hazard (MPPEH)-related discovery were to occur on-site by non-UXO qualified personnel:	M

		• Immediately Stop Work (RECOGNIZE): Do not disturb or move a suspect MEC/MPPEH hazar Only trained UXO Technicians are authorized to investigate potential MEC/MPPEH hazards. Make sure that cell phones/two way radios or other electro-magnetic sources are not engaged in the area of the suspect item. • Secure area/location where the UXO/MPPEH/MEC item is discovered (RETREAT): Stop and secure any operating equipment to the extent possible. Mark the general area/location of the UXO/MPPEH/MEC hazard with tape, colored cloth, or colored ribbon. Avoid using markers tha penetrate the ground surface. • Immediately make notification to TLI (REPORT): Once area has been evacuated, appropriate notifications shall be made immediately to the site Senior UXO Supervisor (SUXOS), UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (UXOQCS), supervisor, project manager. Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features. • Operations cannot resume until such safeguards and approvals are in place to safely continue the assigned work. • Observe the requirements of Explosives Safety and Health Requirements Manual, Engineering Manual (EM) 385-1-97.	
• Battery Charging and Storage/Handling	• Battery Storage and Handling	• Read and follow all the requirements of EM 385-1-1, Section 11.G, some of which are provided below. • Batteries shall be stored in well-ventilated rooms and arranged to prevent escape of liquid electrolyte into other areas. • Racks/trays shall be substantial and shall be treated to make them resistant to the electrolyte. • Floors shall be of acid resistant construction or protected from accumulation of acid. • Facilities for quick drenching of the eyes and body shall be provided for emergency use within 25-ft of battery handling areas. • Use only insulated tools in the battery area to prevent accidental shorting across battery connections. • For lead acid batteries, bicarbonate of soda to neutralize any acid spillage (1-lb/gal) shall be provided for flushing and neutralizing spilled electrolyte and for fire protection. • Ensure the following PPE is available and used for safe battery handling: o Goggles and face shields appropriate to the chemical and electrical hazard o Acid-resistant rubber gloves o Protective rubber aprons and safety shoes o Lifting devices of adequate capacity, when required	L
	• Battery Charging	• Read and follow all the requirements of EM 385-1-1, Section 11.G, some of which are provided below. • Battery charging installations shall be located in areas designated for that purpose. • Charging apparatus shall be protected against physical damage • When charging batteries, the vent caps shall be kept in place to avoid spray of electrolyte and care should be taken to assure vent caps are functioning. • Prior to charging batteries, the electrolyte level shall be checked and adjusted to the proper level if necessary • Exit route from battery area shall remain unobstructed. • Ensure the following PPE is available and used for safe battery handling: o Goggles and face shields appropriate to the chemical and electrical hazard o Acid-resistant rubber gloves o Protective rubber aprons and safety shoes o Lifting devices of adequate capacity, when required	L

Equipment Used	Inspection Requirements	Training Requirement
• Geonics EM61 MK2 • Geonics EM31 • Trimble GPS Survey Equipment	• Visual inspection to be followed by instrument calibration • Visual inspection to be followed by instrument calibration • Visual inspection. Reception of satellites and radio signal will attest to proper operation	Personnel must have, practice, and ensure: • Equipment Operator will have previous experience and training in the use of the equipment; • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Techniques for MEC/UXO avoidance; • Safe work practices and precautions associated with task being performed in accordance with the QAPP; • Evacuation and emergency procedures in accordance with the ERP/Site Safety and Health Plan (SSHP); • UXO identification and safety precautions for UXO personnel are conducted in accordance with the QAPP/SSHP; and • OSHA qualifications and training as required in accordance with the QAPP/SSHP.

AHA-6: Reacquisition and Intrusive Removal of Anomalies	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: Anomaly reacquisition and removal of subsurface Munitions and Explosives of Concern (MEC) and Munitions Debris (MD) using the Mag and Dig removal method.		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Anomaly reacquisition and removal/inspection of subsurface anomalies using the Mag and Dig removal method	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M

	• MEC hazards (unintentional detonations)
	• Chemical Warfare Material (CWM)
	• Excavations by earth moving machinery (EMM)
		• When marking target anomalies for removal, ensure fiberglass shaft pin flags and brightly colored surveyors tape and/or high visibility, biodegradable spray paint are used, as required.
		• Ensure UXO trained and qualified personnel (IAW DDESB TP 18) are escorting or performing the work.
		• Ensure proper exclusion zones are in place and monitored during MEC work with only essential personnel within the EZ.
		• Ensure proper team separation distances (TSDs) are followed.
		• Ensure all the requirements of MEC SOPs are followed. some of which are outlined below:
		  • Start all excavations from the side of the anomaly. Carefully dig from the side until identification of the anomaly is made.
		  • Excavation operations, whether by hand or EMM, will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over suspected MEC.
		  • Move with slow, deliberate motions; avoid abrupt moves, avoid impacting, jarring, or striking UXO. Do not subject UXO to shock, rough handling, heat, or any other force.
		  • Radios shall not be used within the minimum safe distance (MSD) from MEC as specified in Department of Army (DA) Pamphlet (PAM) 385-64, Section 3, paragraph 17-15.g (e.g., the MSD of 5 feet is prescribed for citizens band radios or walkie-talkies). Cell phones shall not be used within the vicinity of suspect ordnance items (EM 385-1-97).
		• EMM operations will not be used to excavate within 12 inches of an anomaly. Once the EMM is within 12 inches of the anomaly, the excavation will be completed by hand methods.
		• When using multiple EMMs, the same MSDs for multiple teams apply.
		• If suspected CWM is encountered, all work will immediately cease and personnel will withdraw upwind.
		• Only Tech Escort Unit personnel will treat/dispose of munitions with CWM or unknown fillers.
		• Onsite communications must be established before work can commence.
		• Intrusive operations will not be performed if electrical storms are within 10 miles of clearance operations.
		• At a minimum PPE will include safety-toed boots, hard hats (when needed), safety glasses, and chemical resistant gloves.	

• Mobilize	• Unfamiliarity with site, site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• Read and follow the Quality Assurance Project Plan (QAPP)/Accident Prevention Plan (APP) and U.S. Army Corps of Engineers (USACE) Safety Concepts for MEC operations. • Check field vehicle for necessary vehicle equipment (i.e., ice scrapers, fire extinguishers, first aid kits, etc.) and road safety kit. Also check field vehicle tire conditions and lights. • Verify that Emergency Medical Services (EMS) are available and can respond in a prompt manner prior to the start of work. • Ensure Base or local EMS and Fire Dispatch numbers programmed into cellular phones. • Ensure hospital route maps are readily available. • Ensure buddy system is maintained for all phases of work. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Contact SSHO immediately for any work-related incidents and near misses. • All employees have the right and responsibility to stop work for any unsafe conditions that cannot be immediately corrected. Contact Site Safety and Health Officer (SSHO) immediately upon stoppage. • All personnel's Occupational Safety and Health Administration (OSHA) certifications must be current. • All personnel must be aware of the Personal Protective Equipment (PPE) requirements (Level D).	L
• Evacuation of non-essential personnel	• Unintentional detonation	• Evacuate all non-essential personnel to outside the designated EZ as specified in the Department of Defense Explosives Safety Board (DDESB)-approved ESS. • Use these personnel as road guards to ensure unauthorized visitors do not enter EZ.	M
• Locate anomalies • Intrusively investigate anomalies • Identify MEC	• Utility hazards	• Obtain proper utility clearance (and dig permit, where applicable).	L
	• Back injuries	• Use proper lifting techniques and use a buddy for heavier lifts.	L
	• Lacerations	• Wear leather gloves when handling MEC/MD. • Items to be handled shall be inspected for sharp edges prior to being handled. • Personnel shall be aware of and avoid pinch point hazard.	L
Equipment Used	**Inspection Requirements**	**Training Requirement**	
• Hand Tools, non-powered • Communications Equipment • Hand-held magnetometers	• Construction equipment safety inspection. • Daily communications checks • In accordance with manufacturers recommendations and daily operational QC checks	Personnel must have, practice, and ensure: • Equipment Operator familiarity with equipment; • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Techniques for MEC/Unexploded Ordnance (UXO) avoidance; • Safe work practices and precautions associated with task being performed in accordance with the QAPP; • Evacuation and emergency procedures in accordance with the ERP/SSHP; • UXO identification and safety precautions for UXO personnel in accordance with the QAPP/Site Safety and Health Plan (SSHP); • Occupational Safety and Health Administration (OSHA) qualifications and training as required in accordance with the QAPP/SSHP; and • Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW), and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities," most current version.	

AHA-7: Excavation with Earth Moving Machinery (EMM)	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: Excavation of individually anomalies, instrument-assisted visual inspection of excavated soils, and backfilling of excavation		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Excavation of individually anomalies, instrument-assisted visual inspection of excavated soils, and backfilling of excavation	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Mobilize	• Unfamiliarity with site, site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures	• Read and refer to the Site Safety and Health Plan (SSHP) Section 5.3.7, Excavation and Trenching Safety. • Read and follow the Quality Assurance Project Plan (QAPP)/Accident Prevention Plan (APP) and U.S. Army Corps of Engineers (USACE) Safety Concepts for Munitions and Explosives of Concern (MEC) operations. • Check field vehicle for necessary vehicle equipment (i.e., ice scrapers, fire extinguishers, first aid kits, etc.) and road safety kit. Also check field vehicle tire conditions and lights. • Verify that Emergency Medical Services (EMS) are available and can respond in a prompt manner prior to the start of work. • Ensure Base or local EMS and Fire Dispatch numbers are programmed into cellular phones. • Ensure hospital route maps readily available. • Ensure buddy system is maintained for all phases of work. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Contact Site Safety and Health Officer (SSHO) immediately for any work-related incidents and near misses. • All employees have the right and responsibility to stop work for any unsafe conditions that cannot be immediately corrected. Contact SSHO immediately upon stoppage. • Ensure all personnel's Occupational Safety and Health Administration (OSHA) certifications are current. • All personnel must be aware of the Personal Protective Equipment (PPE) requirements (Level D).	L
• Excavate individual subsurface anomalies to depth, and when necessary, using EMM	• Direct contact with MEC; impacting, jarring, or striking	• Use anomaly avoidance procedures. EMM will not be used to excavate within 12 inches of suspected MEC. • Perform all high-input mechanized MEC procedures in accordance with the DDESB-approved ESS. • Excavate in 6-inch lifts in accordance with the QAPP.	M
	• Unplanned detonation	• Evacuate all non-essential personnel to outside the designated exclusion zone as specified in the DDESB-approved Explosives Safety Submission (ES). • Secure the site to ensure unauthorized personnel do not enter exclusion zone (EZ). • Use shielding and hearing protection to protect from fragmentation and overpressure hazards appropriate for the munition of interest.	M
	• Utility hazards	• Obtain proper utility clearance (and dig permit, where applicable).	L

	- Open excavation fall hazards	- Prohibit all personnel from entering any excavation deeper than 5 feet. - Use temporary fencing with gated entry point around the trench area to prevent non-essential personnel from entering. - A Competent Person (CP) must conduct routine visual inspections before work start and routinely to document absence of sloughing/danger of collapse. - Be aware of equipment location and swing radius, use spotters, and establish eye contact with operator. - Wear high visibility vest. - Pay attention to suspicious odors. If suspicious odor is noticed, a step back will occur while the potential source is evaluated (e.g., via monitoring). - Place excavated soil/debris a minimum of 2 feet from the excavation opening. - Personnel and EMM wheels/tracks must remain a minimum of 2 feet from the excavation opening.	L
- Conduct instrument-assisted visual inspection of excavated soils	- Unplanned detonation	- Evacuate all non-essential personnel to outside the designated EZ as specified in the DDESB approved ESS.	M

Equipment Used	**Inspection Requirements**	**Training Requirement**
- EMM (e.g., mini excavator) - Communications Equipment - Hand-held magnetometers	- Construction equipment safety inspection - Daily communications checks - Excavation inspection (as required) - Instrument QC checks	Personnel must have, practice, and ensure: - Equipment Operator familiarity with equipment; - Excavation Competent Person Training; - Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); - Techniques for MEC/Unexploded Ordnance (UXO) avoidance; - Safe work practices and precautions associated with task being performed in accordance with the QAPP; - Specific response training in accordance with the QAPP/Site Safety and Health Plan (SSHP); - Evacuation and emergency procedures in accordance with the ERP/SSHP; - UXO identification and safety precautions for UXO personnel in accordance with the QAPP/SSHP; - OSHA qualifications and training as required in accordance with the QAPP/SSHP; and - Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW) and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in DDESB Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities," most current version.

AHA-8: MEC Disposal Operations	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: Planned detonation of Munitions and Explosives of Concern (MEC)		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Conduct MEC disposal operations • Evacuation of nonessential personnel • Preparing and placing charges • Detonation	• General site-wide hazards • Unintentional detonation • Lacerations • Back injuries • Noise hazard • Flying debris	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards. • Evacuate all nonessential personnel to outside the designated exclusion zone (EZ) as specified in the Department of Defense Explosives Safety Board (DDESB) approved Explosives Safety Submission (ESS). • Secure the site to ensure unauthorized personnel do not enter EZ. • Wear gloves when handling MEC. • Use proper lifting techniques. • Wear hearing protection when needed. • Use engineering controls (sandbags) to mitigate fragmentation distance.	M
	• Preparation of Demolition Shot	Demolition shot preparation will follow all procedures outlined in the MEC SOPs, some of which are presented below: • Personnel not involved in the disposal operations will act as perimeter guards as directed by the Demolition Supervisor; • The K328/fragmentation distance for each shot will not exceed the K328/fragmentation distance specified in the approved ESS; • Priming shots will occur only after all non-essential personnel have left the EZ, perimeter guards have been positioned, and the required personnel have been notified; • Activity not associated with the disposal operations will cease and personnel and equipment will be evacuated from the EZ; • The Demolition Supervisor will ensure the appropriate notifications have been completed before commencing the operation; • No smoking, open flame, or fire of any kind within 50 feet of any area where explosive materials are located; • A designated vehicle will be positioned near the disposal area, with engine running, and directed toward the emergency escape route; • A minimum of two qualified personnel, one of which will be the Demolition Supervisor, will conduct disposal operations; • All demolition shots will be dual primed; • The maximum quantity of explosives that may be disposed of at one time will include the net explosive weight of the item(s) to be disposed of, plus the weight of the donor charge; • Explosive materials will be removed from containers only as they are needed for immediate use; • Priming setups will only be assembled as they are needed; • Preparation of electric blasting caps will be accomplished at least 50 feet from other explosive materials; • The Demolition Supervisor will direct the placement of the initiating explosives. Charges will be placed in such a manner to take full advantage of the effect of the initiating explosive and contribution from the explosive content of the MEC being detonated; and	M

		• Blasting caps or detonators will be attached to the main charge using detonating cord. Only the Demolition Supervisor and one other fully qualified UXO technician will remain downrange to attach the firing system to the donor charges. All other personnel will move to the safe area. • Follow all misfire procedures outlined in the MEC SOPs. • At a minimum, PPE will include safety-toed boots, hard hat, safety glasses, and chemical-resistant gloves. All operations involving detonation of explosives will use the following safety signals. Employees will be made familiar with the signals and actions to be taken: • WARNING SIGNAL – A series of long audible signals 5 minutes before blast signal. • BLAST SIGNAL – A series of short audible signals 1 minute prior to the shot. • ALL CLEAR SIGNAL – A prolonged audible signal following the inspection of the disposal site.	
Equipment Used	**Inspection Requirements**	**Training Requirement**	
• Heavy Equipment • Hand Tools, non-powered • Communications Equipment	• Construction equipment safety inspection • Daily communications checks	Personnel must have, practice, and ensure: • Equipment Operator familiarity with equipment; • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Techniques for MEC/Unexploded Ordnance (UXO) avoidance; • Safe work practices and precautions associated with task being performed in accordance with the Quality Assurance Project Plan (QAPP); • Specific response training in accordance with the QAPP/Site Safety and Health Plan (SSHP); • Evacuation and emergency procedures in accordance with the ERP/SSHP; • UXO identification and safety precautions for UXO personnel in accordance with the QAPP/SSHP; • Occupational Safety and Health Administration (OSHA) qualifications and training as required in accordance with the QAPPP/SSHP; and • Unexploded Ordnance Technicians (UXOT's), UXO Qualified Personnel (UXOQP), Site Workers (SW) and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in DDESB Technical Paper (TP)-18, "Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities," most current version.	

AHA-9: Material Potentially Presenting an Explosive Hazard (MPPEH) Processing	**Overall Risk Assessment Code (RAC): M**	Date: November 2020
		Project: Longhorn Army Ammunition Plant
Description of Activity: MPPEH inspection process and associated handling and storage of munitions debris (MD) and range related debris (RRD)		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Conduct MPPEH Processing	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	
• Carrying/handling MD and NMRD to collection and storage points • Sorting of MD and NMRD • Packaging MD and NMRD for off-site recycle	*These potential hazards apply to all three principle steps in the left hand column:* • Lacerations from sharp metal • Back injuries • Noise exposure • Being injured while heavy equipment is in use	*These recommended hazard controls apply to all three principle steps in the left hand column:* • Wear leather gloves, be alert for sharp edges and pinch point hazards. Items to be handled shall be inspected for sharp edges prior to being handled. • Use proper lifting techniques; use a buddy or mechanical assists when lifting heavier items/loads. • Use hearing protection if it is difficult to talk when standing three feet apart. • Use spotters and backup alarms on heavy equipment. • Do not approach heavy equipment until eye contact is made with operator and a signal is given. • Use qualified operators. • Wear hard hats/high-visibility vests when heavy equipment is in use.	
• Discovery of MEC while inspecting/processing MPPEH	• Explosive hazards • Unintentional detonations	During the MPPEH inspection process, if MEC or suspected MEC is encountered, the SUXOS will: • Direct all operations in the vicinity to cease and evacuate the immediate area. • Perform a full inspection and verify by re-inspection (UXOSO) to determine if it is safe to move. • If the item is determined safe to move, it will be transported IAW with applicable requirements/guidelines to the MEC consolidation point (e.g., in the grid or the MEC storage magazine) to await disposal. • If the item is determined not safe to move, the item will be protected and guarded IAW applicable guidelines and MEC SOP procedures while awaiting a blow-in-place detonation operation.	M

Equipment Used	Inspection Requirements	Training Requirement
• Heavy Equipment • Hand Tools, non-powered • Communications Equipment • Buckets	• Construction equipment safety inspection • Daily communications checks • Daily inspect buckets for damage and/or handle wear	Personnel must have, practice, and ensure: • Equipment Operator familiarity with equipment; • Knowledge of the Emergency Response and Notifications procedures in accordance with the Emergency Response Plan (ERP); • Safe work practices and precautions associated with task being performed in accordance with the Quality Assurance Project Plan (QAPP); • Specific response training in accordance with the QAPP/Site Safety and Health Plan (SSHP); • Evacuation and emergency procedures in accordance with the ERP/SSHP; • UXO identification and safety precautions for Unexploded Ordnance (UXO) personnel in accordance with the QAPP/SSHP; • Occupational Safety and Health Administration (OSHA) qualifications and training as required in accordance with the QAPP/SSHP; and • Unexploded Ordnance Technicians (UXOT’s), UXO Qualified Personnel (UXOQP), Site Workers (SW) and Sweep Personnel (SP) will meet the Minimum Qualifications as prescribed in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, “Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities,” most current version.

AHA-10: Remediation-Derived Waste Management (RDW)	**Overall Risk Assessment Code (RAC): M**	Date: November 20208 Project: Longhorn Army Ammunition Plant
Description of Activity: Management of remediation-derived waste resulting from field activities.		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Management RDW	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Collect liquid and solid waste streams in separate and appropriate containers • Keep containers closed except when adding waste • Segregate waste streams at the point of generation • Collect waste only in containers in good condition, compatible with the waste stream and Department of Transportation (DOT) compliant • Sample wastes, as applicable • Transport waste containers to accumulation/storage area employing heavy equipment for further disposition	• Equipment decontamination	• Review Equipment Decontamination AHA for identified hazards and controls for decontamination of equipment.	M
	• Chemical/contaminant exposure	• Chemical-resistant gloves that are applicable for the chemical likely to be encountered and eye protection will be worn during sampling and liquid transfer activities. • Sample collection and handling procedures will be followed. • All contaminated water will be disposed of in accordance with all Federal and state requirements. • To prevent spillage, drum lids will be kept tightly closed when not in use. • Fuel spill containment kit will be available.	L
	• Fire - equipment fueling	• Motors must be shut off during refueling. Do not fuel hot equipment. • Smoking in the vicinity of fueling operation is not permitted. • An ABC fire extinguisher must be maintained on all heavy equipment. • Fuel containers will not be stored within 10 feet of the heavy equipment. • Fuel will be stored in Underwriter Laboratory (UL)-approved safety containers with contents clearly labeled. • Fueling area will be maintained free of vegetation and debris with proper signage. • Fuel spill containment kit will be available.	L
	• Injuries from hand tools	• Hand tools will be selected so that the right tool is being used for the right job and being used in the manner in which it was intended to be used. • Hand tools will be inspected daily prior to use and any defective tools will be tagged and removed from service immediately.	L
	• Hand injury	• Use leather work gloves for material handling and moving drums. • Chemical-resistant gloves that are applicable for the chemical likely to be encountered will be worn for sampling and when there is a potential for waste liquid contact. • Verify that loads to be handled are free of sharp edges and points. • Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact/pinch points. • Keep hands away from all moving equipment parts.	L
	• Noise	• All personnel in area of pumps, generators, and heavy equipment will wear hearing protection.	L
	• Eye injury	• All sampling personnel will wear safety glasses to prevent liquid splashing into eyes. • Verify that eyewash equipment is available and maintained, as required.	L
	• Injuries from heavy equipment	• Only trained and authorized personnel will operate and/or assist in equipment operations. • Operators must comply will all applicable state certifications. • Prior to use, all equipment will be inspected by Site Safety and Health Officer (SSHO) or designate. • Equipment will be inspected daily and documented by the equipment operator.	L

AHA-10: Remediation-Derived Waste Management (RDW)	**Overall Risk Assessment Code (RAC): M**	Date: November 20208
		Project: Longhorn Army Ammunition Plant
Description of Activity: Management of remediation-derived waste resulting from field activities.		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
		• All rotating parts, pulleys or chains must be covered with protective safety guards. • All personnel working in the area will be instructed on the location and use of the kill switch on the equipment. • Ground personnel will maintain a safe distance from heavy equipment operations. • Personnel are only permitted to approach heavy equipment following eye contact and signal from the equipment operator.	
	• Heavy lifting, back strain, overexertion	• Use best ergonomically designed equipment. • Avoid twisting/turning while pulling on tools and when moving loaded coolers/equipment. • Use mechanical lifting devices whenever possible. • When mechanical lifting devices are not available, use two-person lift. • Use proper lifting techniques. • Lifts greater than 40 pounds require assistance or mechanical equipment. • Carry heavy loads using two hands. • Never carry a load that he or she cannot see around or over. • Observe/evaluate the size, shape, and weight of the object to be lifted. • Clear your path of travel before lifting. • Fingers must be kept away from points that could crush or pinch them, especially when putting an object down. • Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, rough, or slippery surfaces. • The hands and the object should be free of dirt or grease that could prevent a firm grip.	M
	• Decontamination water spills	• All waste handling activity shall be performed on visqueen (polyethylene sheeting)-lined work surfaces. • Waste liquids shall be stored with secondary containment. • Lids and bungs shall be secured when drums are in storage or are being moved. • Spill cleanup equipment shall be readily available when handling wastes. • Drums containing waste shall be inspected on a daily basis. • Spills shall be immediately reported to the SSHO.	L

Equipment Used	**Inspection Requirements**	**Training Requirement**
• Trucks with or without trailers • Bobcat or forklift • Centrifugal pump and/or submersible pump • Shovel and hand tools • Fuel spill containment kit • Fire extinguisher • Portable eye wash bottle	• Inspect proper preparation of soil storage area • Inspect trailer hitches (if used) to assure properly engaged • Inspect equipment • Inspect containers for condition and proper labeling • Inspect spill kit • Inspect fire extinguishers and eye wash bottles	• This task requires a minimum of 40-hour Hazardous Waste Operator (HAZWOPER) with current 8-hour refresher and site-specific hazard communication training. • Operators will be trained in the safe use of required equipment and in the required personal protective equipment.

AHA-11: Soil Sampling	**Overall Risk Assessment Code (RAC): M**	Date: November 2020
		Project: Longhorn Army Ammunition Plant
Description of Activity: Performing soil sampling activities		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Perform soil sampling activities	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Collect soil sample • Cleaning of sampling tools • Disposal of sampling waste • Labeling of waste container • Documenting sample locations using labeled survey lathe or pin flags (as needed) • Preparing labels for shipping	• Equipment decontamination	• Review Equipment Decontamination AHA for identified hazards and controls for decontamination of equipment.	M
	• Munitions and Explosives of Concern (MEC)	• Where MEC is potentially present, Unexploded Ordnance (UXO) trained personnel will escort non-UXO personnel at all times. • In the event a potential MEC/material potentially presenting an explosive hazard (MPPEH) related discovery were to occur on-site by non-UXO qualified personnel: o **Immediately Stop Work (RECOGNIZE):** Do not disturb or move a suspect MEC/MPPEH hazard. Only trained UXO Technicians are authorized to investigate potential MEC/MPPEH hazards. Make sure that cell phones/two way radios or other electro-magnetic sources are not engaged in the area of the suspect item. o **Secure area/location where the UXO/MPPEH/MEC item is discovered (RETREAT):** Stop and secure any operating equipment to the extent possible. Mark the general area/location of the UXO/MPPEH/MEC hazard with tape, colored cloth, or colored ribbon Avoid using markers that penetrate the ground surface. o **Immediately make notification to UXO personnel (REPORT):** Once area has been evacuated, appropriate notifications shall be made immediately to the site Senior UXO Supervisor (SUXOS), UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (UXOQCS), supervisor, and project manager (PM). Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features. • Operations can not resume until such safeguards and approvals are in place to safely continue the assigned work. • Observe the requirements of Explosives Safety and Health Requirements Manual, Engineering Manual (EM) 385-1-97.	M
	• Contact with surface/subsurface anomalies or bulk energetic material, if applicable	• Sampler will be escorted at all times by a qualified UXO technician to provide anomaly avoidance procedures prior to collecting samples, if MEC is potentially present.	M
	• Exposure to contaminants	• Personnel will receive site specific training for recognition of potential contaminants. • Use sampling equipment to handle materials remotely. • Work upwind of the sample. • Wear proper Personal Protective Equipment (PPE) (safety vest, boots, safety glasses, hard hat, nitrile gloves, and work uniform) and minimize contact with soil, etc. • Wear coated coveralls and a face shield if splashing is a problem. • Always keep dust to a minimum.	L
	• Eye hazards	• Eye/face protection shall be worn during all decontamination tasks. • Verify that eyewash equipment is available and maintained.	L
	• Ergonomic hazards (e.g., awkward postures, excessive forces)	• Personnel will use good ergonomic practices and either utilize mechanical lifting devises or request assistance with heavy objects or material. • No individual employee is permitted to lift any object that weighs over 40 pounds.	L

		• Proper lifting techniques shall be used. • Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 40-pound limit.	

Equipment Used	**Inspection Requirements**	**Training Requirement**
• Emergency Equipment - first aid kit, fire extinguisher, eye wash station • Level D PPE	• Sampling equipment to be inspected daily and results noted in log book • Fire extinguishers will be inspected and documented monthly with current annual inspection • Initially and at least weekly thereafter or after the first-aid kit is used and restocked • Eye wash will be inspected weekly • All PPE will be inspected prior to use	• Sampling technicians will be trained in the proper use of required sampling and monitoring equipment, and PPE • Current Occupational Safety and Health Administration (OSHA) Hazardous Waste Operator (HAZWOPER) Training. •

AHA-12: Equipment Decontamination	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant	
Description of Activity: Decontamination of equipment		Reviewed: Erika Erikson Prepared: Owens Carter Last Updated: N/A	
Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Decontaminate equipment	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Move equipment into decontamination area • Wash all contaminated surfaces using water and brushes • Transfer wastewater to drums or tanks	• Chemical/contaminants exposure	• Maintain separate work zones and decontamination areas. • Level D -Modified personal protective equipment (PPE) shall be worn as required in the SSHP to include polyvinyl chloride raincoat and face splash shield. • Spill response preparedness will include a spill containment kit and spill prevention inspections. • Personnel shall perform proper personal decontamination procedures each time when exiting the decontamination area. • Fuel spill containment kit will be available.	L
	• Electrical injury	• Ground Fault Circuit Interrupters (GFCIs) shall be used on all power tools and extension cords. • Extension cords, power tools, and lighting equipment shall be inspected before each use, protected from damage, and kept out of wet areas.	M
	• Heavy lifting, back strain, overexertion	• No individual employee is permitted to lift any object that weighs over 40 pounds. • Proper lifting techniques shall be used. • Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 40-pound limit.	L
	• Eye injury	• Eye/face protection shall be worn during all decontamination tasks. • Verify that eyewash equipment is available and maintained, as required.	L
	• Decontamination water spills	• All waste handling activity shall be performed on visqueen (polyethylene sheeting)-lined work surfaces. • Waste liquids shall be stored with secondary containment. • Lids and bungs shall be secured when drums are in storage or are being moved. • Spill cleanup equipment shall be readily available when handling wastes. • Drums containing waste shall be inspected on a daily basis. • Spills shall be immediately reported to the Site Safety and Health Officer (SSHO).	L
	• Water tanks	• All water tanks must be securely fastened to the truck frame. • Water tanks should be constructed of materials with adequate side strength, baffled to prevent the sloshing of water side to side, and must have lids with gaskets to prevent water loss.	L

Equipment Used	Inspection Requirements	Training Requirement
• Long handle brushes/ scrapers • Shovel and sediment containers • Drums or storage tanks • Spill containment kit • Portable eye wash bottle • Level D -Modified personal protective equipment	• Inspect pressure washer and hoses for safe operating condition • Inspect equipment for adequate decontamination • Inspect spill kit • Inspect eye wash bottles	This task requires a minimum of 40-hour Hazardous Waste Operator (HAZWOPER) with current 8-hour refresher and site-specific hazard communication training. All site personnel will be trained in the safe use of specific equipment and in PPE required to perform their job. Personnel must also be trained in: • Spill prevention/response procedures; and • Respiratory Protection Program, as applicable.

AHA-13: Site Restoration	**Overall Risk Assessment Code (RAC): M**	Date: November 2020 Project: Longhorn Army Ammunition Plant
Description of Activity: Perform site restoration activities		Reviewed: Erika Erikson Prepared: Kyra Donnell Last Updated: N/A

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
• Perform site restoration activities	• General site-wide hazards	• Review General Site-Wide AHA for identified hazards and controls for various site-wide hazards.	M
• Backfilling operations and site restoration	• Pedestrians or unauthorized vehicles entering work area	• Set up exclusion zone (EZ). • Use spotters to watch for unauthorized pedestrians or vehicles entering the EZ. • Stop work if an unauthorized person enters the EZ.	L
	• Striking overhead lines or objects with the equipment bucket or the dump bed of the truck	• Before beginning work, walk the EZ looking for overhead obstructions or power lines.	M
	• Heavy lifting, back strain, overexertion	• No individual employee is permitted to lift any object that weighs over 40 pounds. • Proper lifting techniques shall be used. • Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 40-pound limit.	L
	• Heavy equipment injuries	• Wear proper Personal Protective Equipment (PPE) including a reflective vest. • Stay out of the swing or travel radius of the equipment and trucks. • Use good communication/hand signals and eye contact with the operator/truck driver. • Do not approach equipment or trucks until they have acknowledged you. • Place equipment bucket on the ground, parking break sett and engine shut down during conversations. • Stay out of blind spots. • All equipment and trucks have functioning back-up alarms. • Spot equipment or trucks working in tight locations and while backing.	L
	• Noise exposure	• Wear approved hearing protection when working close enough to equipment or trucks that you have to speak louder than your normal voice to someone standing next to you.	L
	• Inhalation of dust	• Wear appropriate PPE to protect from dust. • Use dust suppression methods (fine water spray), if required. Control flow to prevent saturation and run off.	L

Equipment Used	**Inspection Requirements**	**Training Requirement**
• Spill containment kit • Portable eye wash bottle • Level D -Modified personal protective equipment	• Inspect equipment prior to use • Inspect spill kit • Inspect eye wash bottles	This task requires a minimum of 40-hour Hazardous Waste Operator (HAZWOPER) with current 8-hour refresher and site-specific hazard communication training. All site personnel will be trained in the safe use of specific equipment and in personal protective equipment required to perform their job. Personnel also must have training in: • Spill prevention/response procedures; and • Respiratory Protection Program, as applicable.

AHA–14 Coronavirus Disease (COVID-19) Pandemic	**Overall Risk Assessment Code (RAC): M**	Date: December, 2020
		Project: LHAAP Environmental Services Military Munitions Response Program
Description of Activity: COVID-19 Prevention Measures and Guidance		Reviewed: Erika Erikson
		Prepared: Owens Carter
		Last Updated: August 2021

Principle Steps	**Potential Hazards**	**Recommended Hazard Controls**	**RAC**
1. Avoid being exposed to the virus 2. Practice social distancing 3. Protect yourself and others 4. Cleaning surfaces and disinfection 5. Watch for symptoms	The virus is thought to spread mainly from person-to-person. ✓ Through respiratory droplets produced when an infected person coughs, sneezes or talks. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. ✓ Some recent studies have suggested that COVID-19 may be spread by people who are not showing symptoms. ✓ Not following social distancing guidelines Virus can spread from contact with contaminated surfaces or objects. It may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes.	• **Call your doctor:** If you think you have been exposed to COVID-19 and develop a fever and symptoms, such as cough or difficulty breathing, **call your healthcare provider** for medical advice. - Symptoms of COVID-19 range from mild symptoms similar to the flue to severe illness and death. These symptoms may appear 2-14 days after exposure (based on incubation period of the virus) and present with: o Fever or chills o Cough o Shortness of breath or difficulty breathing o Fatigue o Muscle or body aches o Headache o New loss of taste or smell o Sore throat o Congestion or runny nose o Nausea or vomiting o Diarrhea • **Avoid close contact:** - Avoid close contact (within 6 feet for 15 minutes or more during a 24 hour period) - Avoid close contact with people who are sick. - Follow all directives and guidance from local, state and federal authorities. - Stay home as much as possible. - Practice social distancing. Put a 6-foot distance between yourself and other people whenever possible. - Remember that some people without symptoms may be able to spread the virus. - Keeping distance from others is especially important for people who are at higher risk e.g. the elderly, people with underlying medical conditions. - If you or a member of your household are showing symptoms or test positive for the virus, notify your supervisor and self-quarantine for two weeks to avoid the potential to spread the virus to others. • **Wash your hands often:** - Wash your hands often with soap and water for at least 20 seconds especially after you have been in a public place, or after blowing your nose, coughing, or sneezing. - If soap and water are not readily available, use a hand sanitizer that contains at least 60% alcohol. Cover all surfaces of your hands and rub them together until they feel dry. - Avoid touching your eyes, nose, and mouth with unwashed hands. • **Cover your mouth and nose with a cloth face cover when around others:**	M

		- CDC advises the use of simple cloth face coverings for all individuals when indoors and for crowded outdoor settings.. - You could spread COVID-19 to others even if you do not feel sick. - Cloth face coverings fashioned from household items or made at home from common materials at low cost can be used as an additional, voluntary public health measure. - Be careful not to touch the eyes, nose, and mouth when removing your face covering and wash hands immediately after removing when possible. - Continue to keep 6 feet between yourself and others. The cloth face cover is not a substitute for social distancing. • **Cover coughs and sneezes** - If you are in a private setting and do not have on your cloth face covering, remember to always cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. - Throw used tissues in the trash. - Immediately wash your hands with soap and water for at least 20 seconds. If soap and water are not readily available, clean your hands with a hand sanitizer that contains at least 60% alcohol. • **Clean and disinfect** - Clean AND disinfect frequently touched surfaces daily. This includes tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, and sinks. - Clean AND disinfect frequently touched surfaces of company and/or rental vehicles (steering wheel, gear shift, turn signal, etc.) - If surfaces are dirty, clean them: Use detergent or soap and water prior to disinfection. - To disinfect, most common EPA-registered (e.g. Lysol, Clorox, Purell) household disinfectants will work. Use disinfectants appropriate for the surface according to manufacturer’s instructions. If commercial disinfectants are not available, a 10% bleach solution may be used. - Cloth face coverings can be washed or otherwise cleaned regularly depending on the frequency of use. A washing machine with hot water and detergent should suffice in properly washing a face covering. • **Minimize the sharing of tools, equipment, etc. as much as possible. If you have to share, clean and disinfect frequently.** • **Consider advance work planning and coordination of tasks that will minimize working in close proximity to each other.**	

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Activity Hazard Analysis (AHA) – 01

Task: General Site Activities	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Level D PPE (Long pants, shirts with minimum 4" sleeve, steel toe boots, safety glasses, hard hat for overhead hazards, leather work gloves, and hearing protection, as required)	**Location:** Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazards	Recommended Controls
Mobilization/Demobilization and Site Preparation Hazards associated with Mobilization/Demobilization and Site Preparation are applicable throughout the project Note: Each workday shall begin with a mandatory daily safety meeting for all on-site workers	Slips, trips, or falls on walking and working surfaces	• Determine the best access route prior to transporting equipment and tools • Continuously inspect the work area for slip, trip, and fall hazards • Pay attention; ensure safe and secure footing • Maintain clean work areas by following good housekeeping procedures • Be alert for uneven and variable terrain • Wear slip resistant footwear when walking/working on slippery surfaces or slopes • Fall protection is required for all work > 6 feet in elevation • All ladders must be free of damage and/or defects and used according to manufacturer's instructions
	Site Traffic	• Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site
	Eye injury	• Use approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet American National Standards Institute (ANSI) Standard Z89.1 in all areas with overhead hazards
	Cuts, punctures, and abrasions	• Wear leather work gloves when handling materials or using tools
	Dropped objects	• Steel toe boots meeting ANSI Standard Z41 will be worn
	Electrical	• All power will be equipped with Ground Fault Circuit Interrupter (GFCI) • All cords and power tools will be inspected prior to use looking for frays, missing ground prongs or other damage; all damaged equipment or cords will be tagged and taken out of service • All power tools must be grounded or double insulated • All cords used must be construction / hard use grade and must be protected from damage

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Mobilization/Demobilization and Site Preparation (continued)	Thermal Stressors (i.e. heat or cold stress)	• Employees will have appropriate clothing for variable weather • Use of long sleeves or application of sunscreen with a high sun protection factor (SPF) on exposed skin encouraged • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat stress • To prevent cold stress employees will take appropriate warming breaks in pre-designated areas, whole body protection will be worn, employees will be provided warm sweet drinks and soups to facilitate warming and maintain proper hydration, workers shall change into dry clothing should their clothing get wet
	Back Injury from Materials Handling	• Use proper lifting techniques • Loads greater than 50 pounds require assistance (team lift) or mechanical equipment • Prior to lifting, check the load for jagged or sharp edges • Avoid torso twisting motions while handling or moving loads
	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, plants, etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid
Clearing and Grubbing (as needed)	Heavy equipment operation and hand tool hazards	• Use of bush-hog, bulldozer, track hoe by experienced operator only. • Inspect heavy equipment before each use and complete Equipment Checklist • Hand tools (i.e. saws or pruning shears) shall be used over power tools, as feasible • Tools shall be inspected prior to use; damaged tools (frayed wiring, missing ground prong, damaged casing or handle) shall be tagged “damaged – do not use” and taken out of service. • Use leather work gloves for hand protection against scratches and sticks; however, gloves must be removed if using a tool with a rotating bit such as a drill where the glove could get caught while in operation

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Clearing and Grubbing (continued)	Slips, trips, and falls	• Practice good housekeeping and clear loose brush away from work area • Look before stepping to ensure adequate footing
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 Decibels "A-weighting scale" (dBA) (ear muffs or plugs) • The Site Safety and Health Officer (SSHO) will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
	Heavy equipment operation	• Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Only qualified operators are permitted to operate equipment • All personnel working around moving equipment will be required to wear highly visible safety vests • All equipment will be inspected prior to use on a daily basis • All broken or damaged parts will be replaced immediately • Signs, barricades, flagmen, and/or other traffic control devices will be used to control traffic as necessary • Buckets and attachments shall be placed on the ground if operator not at controls or if ground personnel approach
Silt Fence Installation, as needed	Biological hazards (spiders, snakes, plants, etc.)	• Workers will inspect the work area carefully and avoid biological hazards • Look in direction of travel for biological hazards to avoid
	Hand tool hazards	• Hand tools (hammers, shovels) shall be inspected for defects prior to use • Use leather work gloves for hand protection against scratches, sticks, and splinters • Use proper tools for the work

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Silt Fence Installation, as needed (continued)	Back Injury from Materials Handling	• Install silt fence in manageable sections • Use proper lifting techniques • Loads greater than 50 pounds require assistance (team lifting) or mechanical equipment • Prior to lifting, check the load for jagged or sharp edges • Avoid torso twisting motions while handling or moving loads
Excavation, as needed	Heavy equipment operation	• Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, and alerting horns • Operators are required to use seat belts • Equipment must be inspected prior to use daily. An inspection checklist will be completed for each piece of equipment used. Broken or damaged parts will be replaced immediately. • Only qualified operators are permitted to operate equipment • All personnel to wear highly visible yellow or orange safety vests while working around moving equipment • Signs, barricades, and/or other traffic control devices will be used, as necessary • Buckets and attachments shall be placed on the ground if operator not at controls or if ground personnel approach • An exclusion zone shall be delineated around the excavation areas
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • The SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers

AHA – 01 (continued)

<table>
<tr><th>Activity</th><th>Potential Hazards</th><th>Recommended Controls</th></tr>
<tr><td rowspan="2">Excavation, as needed (continued)</td><td>Overhead/buried utilities</td><td>• Area of excavation should be delineated and a utility locate performed prior to any excavation
• Overhead utilities should be considered live until determined otherwise
• Work activity adjacent to overhead electric power lines will not be initiated until a survey has been conducted to ascertain the safe clearance distance from energized lines. Please refer to the U.S. Army Corps of Engineers (USACE) <i>Safety and Health Requirements Manual</i> (EM 385-1-1, 2014) for a complete description of procedures required when working at a location adjacent to overhead power lines. The minimum required clearance distances from energized overhead electric lines are provided below.
Minimum Clearance from Energized Overhead Electric Lines
<table>
<tr><th>Nominal System Voltage</th><th>Minimum Rated Clearance</th></tr>
<tr><td>0 to 50 kV</td><td>3 m (10 ft)</td></tr>
<tr><td>51 to 200 kV</td><td>4.6 m (15 ft)</td></tr>
<tr><td>201 to 350 kV</td><td>6 m (20 ft)</td></tr>
<tr><td>351 to 500 kV</td><td>7.6 m (25 ft)</td></tr>
<tr><td>501 to 650 kV</td><td>9.1 m (30 ft)</td></tr>
<tr><td>651 to 800 kV</td><td>10.7 m (35 ft)</td></tr>
<tr><td>801 to 950 kV</td><td>12.2 m (40 ft)</td></tr>
<tr><td>951 to 1100 kV</td><td>13.7 m (45 ft)</td></tr>
<tr><td colspan="2">Note: kV = Kilovolts, m = Meter, ft = feet</td></tr>
</table></td></tr>
<tr><td>Excavation Safety</td><td>• Ensure equipment is placed so as to not contribute to a cave-in situation
• No personnel will be allowed to enter excavations greater than 4 feet bgs unless the excavation has been properly inspected, shoring and means of egress installed as necessary, all heavy equipment has been moved away from the affected edges, and any spoils have been removed from the edge
• Do not place spoil piles closer than 2 feet from the edge of the excavation
• Open excavations shall be protected with minimum Class III perimeter protection</td></tr>
</table>

AHA – 01 (continued)

Activity	Potential Hazards	Recommended Controls
Excavation, as needed (continued)	Electrical	• Ensure GFCI are used in all outdoor environments and in any areas subject to moisture • Ensure all cords are in good repair. Do not attempt to repair a cord with tape; discard damaged cords immediately. Ensure ground prong is in place and insulation is not damaged on all extension cords/equipment. • Keep cords and electrical tools out of traffic areas where they may be damaged and out of water • Prohibit work on new and existing energized (hot) electrical circuits until all power is shut off and a positive Lockout/Tagout System is in place. ONLY TRAINED ELECTRICIANS ARE PERMITTEED TO WORK ON ELECTRICAL CIRCUITRY. • VIOLATION OF A LOCKOUT TAGOUT REQUIREMENT CAN RESULT IN IMMEDIATE REMOVAL FROM THE JOB SITE AND POSSIBLE TERMINATION FROM THE COMPANY AND/OR BAN ON FUTURE BUISNESS FOR SUBCONTRACTOS

	Unexploded ordnance (UXO) or Munitions and Explosives of Concern (MEC)	• Although not anticipated, as with any military base, the potential exists to encounter UXO; all employees will be instructed on safe procedures to be followed including the following:
		  • Under no circumstances will any Bhate employee or subcontractor employee (other than a UXO Technician) attempt to move or otherwise handle any UXO/MEC or suspected UXO/MEC item.
		  • Collection of “souvenirs” is prohibited, whether rendered safe or not.
		  • If you did not put it there, don’t pick it up! If you cannot recognize the item as a tool, don’t pick it up! Notify a Base UXO technician to inspect the item.
		  • If UXO/MEC items are encountered during heavy equipment operations, work shall be stopped and the item(s) investigated by a Base UXO technician. Work shall not resume until the item has been secured or deemed not an UXO/MEC item.
		  • After the potential encounter with UXO/MEC, the heavy equipment used will be inspected to determine if any UXO/MEC materials had lodged in the tracks, tires, bucket, and other extensions of the equipment.
		  • Three R’s: Recognize, Retreat and Report
		    • Recognize: Don’t touch it.
		    • Retreat: 300 feet
		    • Report to Site Supervisor or UXO Safety Supervisor

AHA – 01 (continued)

Safety Equipment Used	Inspection Requirements	Training Requirements
Level D PPE First Aid Kit Fire Extinguisher Eyewash Use of bush-hog, bulldozer, track hoe, etc. when have to “clear and grub”	Informal daily work area inspections and formal weekly safety inspections to be conducted by the SSHO Inspect heavy equipment before using and complete Equipment Checklist form	Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Site personnel received site-specific safety indoctrination SSHO and one other field employee will have Cardiopulmonary Resuscitation (CPR) and First Aid training

AHA – 02

Task: Groundwater sampling	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves. As needed - chemical impervious gloves [nitrile inner and outer], and hearing protection with a noise reduction rating >26).	**Location:** LHAAP, Karnack, Texas **Analysis Approved by:** Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazards	Recommended Controls
Groundwater sampling Note: Each workday shall begin with a mandatory daily safety meeting even though there may be only one worker onsite. Keeping a safety focus is important.	Slips, trips, or falls on walking and working surfaces	• Determine the best access route prior to transporting equipment and tools • Continuously inspect the work area for slip, trip, and fall hazards • Pay attention; ensure safe and secure footing • Maintain clean work areas by following good housekeeping procedures • Be alert for uneven and variable terrain • Wear slip resistant footwear when walking/working on slippery surfaces or slopes • Provide adequate lighting in all work areas
	Site Traffic	• Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site • All onsite personnel must wear highly reflective orange or yellow safety vests in traffic areas and/or when working around heavy equipment
	Eye injury	• Use approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 in all areas with overhead hazards
	Cuts, punctures, and abrasions	• Wear leather work gloves when handling materials or using tools
	Dropped objects	• Steel-toe safety boots meeting ANSI Standard Z41 will be worn
	Thermal Stressors (i.e. heat stress and/or cold stress)	• Employees will have appropriate clothing for variable weather • Use of long sleeves or application of sunscreen with a high SPF on exposed skin encouraged • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat and/or cold stress

AHA-02 (continued)

Activity	Potential Hazards	Recommended Controls
Groundwater sampling (continued)	Back Injury from Materials Handling	• Inspect travel route prior to lifting/movement of heavy loads • Use proper lifting techniques, bending with the knees, not the back • Avoid torso twisting motions while handling or moving loads • Site personnel will be instructed on proper lifting techniques – bend with the knees and not with the back; avoid twisting at the waist, use your feet to turn • Loads greater than 50 pounds require assistance or mechanical equipment • Mechanical devices should be used to reduce manual handling of materials • Team lifting should be used if mechanical devices are not available • Prior to lifting, check the load for jagged or sharp edges
	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • Implement a 30-minute stand down during lightning events • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid • Wear insect repellant as needed
	Electrical Hazards (Extension cords, Electrical Equipment, Temporary lighting, Building electricity) If necessary	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter (GFCI) outlets may be used at source of power • Ensure cords are protected and run out of travel pathways • Ensure breaker boxes, electrical boxes, junction boxes, outlets, have covers in place. Ensure there are no openings where someone can come in contact with live electricals; all knockout holes are covered with proper plugs. • Do not use metal or other conductive ladders around electrical hazards

AHA-02 (continued)

Activity	Potential Hazards	Recommended Controls
Groundwater sampling (continued)	Exposure to soil and/or water contaminants	• To the extent feasible, limit contact with subsurface contaminants • Wear chemical resistant gloves (nitrile inner and outer) when handling groundwater samples • Wash hands and face prior to eating or drinking after handling potentially contaminated materials
	Spills/Fire	• Fuel cans will be National Fire Protection Association (NFPA) approved and equipped with pouring spout or funnel • Have absorbent materials available to control possible spills or leaks. • Smoking and open flames are not permitted in fueling/greasing areas or in the work area • All heavy equipment will be equipped with a ABC type fire extinguishers which will be inspected weekly and documented • Keep fire extinguishers easy to see and reach in case of an emergency • Store gasoline and other flammable liquids in a safety can with flame arrestor outdoors or in an approved flammable cabinet • Don't store LP gas tanks inside buildings • Keep temporary heaters at least 50 feet away from any LP gas container or any other flammable/combustible material • Ensure that leaks or spills of flammable or combustible materials are cleaned up promptly • Oily or solvent soaked rags must be disposed of in a metal self-closing safety can and must be emptied and properly disposed of on a daily basis
	Noise	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • The SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE First Aid Kit with Eyewash Fire Extinguisher Groundwater pump and tubing Water quality instruments Laboratory-provided sampling containers	Informal daily work area inspections to be conducted by the SSHO Weekly inspection of first aid kit and eye wash Inspect all equipment before use	Site personnel received site specific safety indoctrination Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in this HASP The SSHO will have CPR and First Aid training

AHA - 03

Task: Operation and Maintenance of Groundwater Treatment Plant (GWTP)	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazards	Recommended Controls
Operation and maintenance of GWTP [Note: Hazards and recommended controls from AHA-01 General Site Activities apply as well] Each workday shall begin with a mandatory daily safety meeting even though there may be only one worker onsite. Keeping a safety focus is important.	Noise	• Use hearing protection when working in the immediate vicinity of the noisy motors.
	Slips, Trips, and Falls	• Be aware of surroundings. • Clearly mark aboveground pipes so they are visible or fence off area containing aboveground pipes.
	Insect bites (spiders, snakes, insects)	• Wear DEET (or equivalent) insect repellant while working outside. • Wear long sleeves and pants to minimize exposure to spiders, snakes and insects. • Be aware of surroundings. • Inspect treatment system containers of potential entry points (fans, filters, louvers) for insects to enter and build nests (i.e. wasps) and ensure those entry points are secure, have no damage or openings to the outdoors, and have the correct slot size to prevent insect intrusion. • Wear leather gloves if needed to protect hands from spider/insect bites.
	Contact with moving/rotating machinery	• Moving Parts: **Lock Out/Tag Out Required** • Disable control and power switches before maintaining, servicing, or repairing the system. • Before starting work, disconnect the blower. • Ensure all fasteners are secure. • Tighten hardware and keep all guards in position over fans, impellers, or other moving parts. • Be sure to verify zero energy prior to repairing or performing maintenance to system.
	Fall from unstable ladder	• Inspect ladder before use and ensure it is in good condition (dispose of dangerous or defective ladders). • Secure ladder footing when in use. • Use care when ascending and descending the ladder- do not rush. • Maintain 3 points of contact while using the ladder.

AHA-03 (continued)

Activity	Potential Hazards	Recommended Controls
Operation and maintenance of GWTP (Continued)	Cold stress and heat stress	• Employees will have appropriate clothing for variable weather. • Workers will be trained in the recognition of cold stress and appropriate actions to take. • Workers will watch others for signs and symptoms of cold stress (shivering, numbness, sluggishness). • Take breaks in heated shelters to prevent cold stress. • Drink warm liquids to reduce the susceptibility to cold stress. • Remove outer layer of clothing and loosen other layers to promote evaporation of perspiration upon entering shelter to prevent heat stress. • Use of long sleeves or application of sunscreen with a high SPF on exposed skin encouraged. • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat and/or cold stress.
	Injury from hand tool use	• Inspect all tools before each use. Tag and remove defective tools from service. • Personnel will be familiar in the proper use of hand and power tools. • All power tools will be energized through a GFCI. • Use the appropriate tool for the job. • Wear proper PPE (safety glasses with side shields, safety/insulated boots and work/insulated gloves and hard hat, when overhead hazards)
	Impact with pressurized lines Shock from electrical lines	• Electrical and Pressurized Lines: **Lock Out/Tag Out Required** • Turn OFF electrical power before touching or removing any electrical components. • Keep areas around the blower clean and dry. • Be sure to verify zero energy prior to repairing or performing maintenance to system. • Use appropriate rubber gloves when working on equipment or transmission lines. • Have a person qualified in first aid for electrical shock present at all times when working on electrical equipment. • No one is permitted to work on unprotected energized electrical systems >50 volts without an energized work permit, flash analysis, determination of approach boundaries, PPE, and NFPA 70E training. • If energized electrical work is determined to be necessary, a separate energized electrical work AHA will be required.

AHA-03 (continued)

Activity	Potential Hazards	Recommended Controls
Operation and Maintenance of GWTP (continued)	Exposure to contaminants	• Wear personal protective equipment to reduce potential exposure to contaminants. See Table of Potential Contaminants of Concern in Attachment 1 of the HASP.
Use of PVC glue and primer	Inhalation of Volatile Organic Compounds (VOCs)	• Use glue or primer in open air to minimize exposure. • All containers shall be properly stored and labeled. • Review the MSDS/SDS and complete the chemical-specific hazard communication training. • Follow recommended controls on MSDS/SDS, including any recommended PPE. • NOTE 1: If glues or primers are needed to be used in a small space or other area without good ventilation, modification to this AHA will be submitted to the HSM. • NOTE 2: No confined space entry activities allowed in the project without prior discussion with HSM and revision to the HASP.
Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE First Aid Kit with Eyewash Fire Extinguisher Assorted hand and power tools Ladder PVC glue and primer	Inspect PPE before use Informal daily work area inspections to be conducted by the SSHO Inspect tools and equipment before use	User of tools and ladder should be competent and qualified as determined by supervisor. 40-hour Initial HAZWOPER training, current 8-hour refresher training Training on the HASP Hazard communication training in accordance with the HASP (maintain MSDSs/SDSs for PVC glue/primer in centrally located area) Lockout/Tagout training for authorized workers: General electrical training.

AHA – 04

Task: Management of Investigative Derived Waste (IDW)	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas **Analysis Approved by:** Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Management of IDW [NOTE: The hazards and control measures presented in AHA-01 are applicable to all phases of the project]	Slips, trips, or falls on walking and working surfaces	• Be alert for uneven terrain and steep slopes • Keep work area free of dirt, grease, slippery materials, debris, and tools; practice good housekeeping • Provide adequate lighting in all work areas • Keep all stairways and walkways clear of debris/tools to prevent trips
	Potential for non-work personnel to be injured or contaminated (during staging of roll-off boxes and when waste haulers remove roll-off boxes)	• In areas where traffic control is required, all traffic control devices and methodologies will comply with the U.S. Department of Transportation (DOT) Manual on Uniform Traffic Control Devices (MUTCD, http://mutcd.fhwa.dot.gov) including the use of appropriate roadway markings, highly visible safety vests, and flagmen as needed. • Be aware of potential vehicle traffic while on site • Follow posted warnings and rules for travel around site • All onsite personnel must wear highly reflective ANSI Class 2 safety vests in traffic areas and/or when working around heavy equipment
	Exposure to high noise from heavy equipment and power tools	• Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) • SSHO will determine the need for hearing protection • All equipment will be equipped with manufacturer's required mufflers
	Eye injury	• Use ANSI approved safety glasses with rigid side shields
	Overhead hazards	• Personnel will be required to wear hard hats that meet ANSI Standard Z89.1 in any areas with overhead hazards
	Dropped objects	• Steel toe boots meeting ANSI Standard Z41 shall be worn

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Inclement weather (Thunderstorms and tornadoes)	• Halt activities immediately and take cover during thunderstorm or tornado warnings, shelter in a building if possible, stay away from windows • If outdoors, stay close to the ground • Listen to radio or television announcements for pending weather information • Do not try to outrun a tornado on foot or in a vehicle
	Biological hazards (spiders, snakes, ticks etc.)	• Workers will inspect the work area carefully and avoid placing hands and feet into concealed areas • Look in direction of travel for biological hazards to avoid • Wear insect repellant as needed
	Thermal Stressors and other hazards (i.e. heat stress, cold stress)	• Employees will have appropriate clothing for variable weather • Wear long sleeves and long pants and sunscreen with a high sun protection factor (SPF) on exposed skin • Employees will take breaks and drink plenty of fluids, as necessary, to prevent heat stress alternating between water and Gatorade-type drinks • Take periodic warming breaks and drink warm sweet liquids when working in cold weather • Protect skin from becoming wet in cold weather; replace clothing that becomes wet as soon as possible • Wear insect repellant as needed • Refer to the Bhate Corporate HASP for detailed information on heat and cold stress
	Overhead/buried utilities	• Conduct a utility locate to identify the location of underground utilities in locations where drilling activities will occur • Overhead utilities should be considered live until determined otherwise • Maintain a minimum distance of > 25 feet from overhead utilities • All underground utilities must be clearly marked before beginning work • No intrusive work shall be conducted within a 4 foot “Buffer Zone” of any underground utility marking

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Spills/Fire	• Fuel cans will be NFPA approved and equipped with pouring spout or funnel • Spill and absorbent materials will be readily available • Smoking and open flames are not permitted in fueling/greasing areas or in the work area • All heavy equipment will be equipped with a ABC type fire extinguishers which will be inspected weekly and documented • Provide fire extinguishers near all welding, soldering, or other sources of ignition • Keep fire extinguishers easy to see and reach in case of an emergency • Store gasoline and other flammable liquids in a safety can with flame arrestor outdoors or in an approved flammable cabinet • Ensure that leaks or spills of flammable or combustible materials are cleaned up promptly • Oily or solvent soaked rags must be disposed of in a metal self-closing safety can and must be emptied and properly disposed of on a daily basis
	Sharp objects, if encountered	• All exposed sharp objects that could cut or impale someone must be protected (i.e. rebar caps - mushroom type is not acceptable for impalement protection) • All exposed nails must be bent over or removed; all loose nails must be kept off the ground • Wear leather or Kevlar gloves while handling sharp objects to prevent lacerations
	Electrical, when used	• Ensure ground fault circuit interrupters (GFCI) are used in all outdoor environments, in any areas subject to moisture, and for all temporary power • Ensure all cords and electrical tools are in good repair. Do not attempt to repair a cord with tape; discard damaged cords immediately. Ensure ground prong is in place and insulation is not damaged on all extension cords/equipment. • Ensure breaker boxes, electrical boxes, junction boxes, outlets, have covers in place. Ensure there are no openings where someone can come in contact with live electricals; all knockout holes are covered with proper plugs. • Keep cords and electrical tools out of traffic areas where they may be damaged • Prohibit work on new and existing energized (hot) electrical circuits until all power is shut off and a positive Lockout/Tagout System is in place. ONLY TRAINED ELECTRICIANS ARE PERMITTED TO WORK ON ELECTRICAL CIRCUITRY. • VIOLATION OF A LOCKOUT/TAGOUT REQUIREMENT CAN RESULT IN IMMEDIATE REMOVAL FROM THE JOB SITE AND TERMINATION FROM THE COMPANY AND/OR BAN ON FUTURE BUSINESS FOR SUBCONTRACTORS

AHA – 04 (continued)

Activity	Potential Hazard(s)	Control Measures
Management of IDW (continued) [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Ergonomics	• Avoid awkward postures • Avoid repetitive motions; switch hands and take rest breaks to give your affected body parts time to rest • Avoid excessive contact stress; provide padding if contact with a fixed object is prolonged such as the floor or a wall
	Vehicular traffic in work area and heavy equipment operation	• Wear ANSI Class II reflective traffic vest and cordon off work area • Maintain awareness of vehicle movement in work area and exercise caution when approaching heavy equipment exercise caution when approaching heavy equipment • Equipment will be equipped with functioning back-up alarms, signal lamps, lights, and alerting horns • Operators are required to use seat belts at all times • Only qualified / licensed operators will operate mobile equipment • All equipment must be inspected using the appropriate forms prior to use on each day of use
	Exposure to potential contaminants during management of IDW	• Wear appropriate PPE including chemical resistant gloves (nitrile inner and neoprene outer) and Tyvek coveralls to minimize potential contact with soil or groundwater, as appropriate • Conduct work activities in a manner that minimizes potential contact with soil or groundwater • Collect all PPE and disposable sampling equipment and place in properly labeled DOT container for proper disposal • Wash hands and face prior to eating, drinking, or smoking

Equipment Used	Inspection Requirements	Training Requirements
Level D PPE Fire Extinguishers First Aid Kits Eyewash	Employees inspect their own PPE. Weekly inspections will be performed on fire extinguishers. Weekly inspections will be performed on first aid kits and eyewash. Informal daily inspections are to be conducted by the SSHO. Formal weekly safety inspections are to be conducted and documented on field inspection form by the SSHO.	Personnel have read and understand the HASP, hospital route map, SDSs and AHAs At least two designated individuals onsite will have current CPR and First Aid training

AHA – 05

Task: Soil sampling and boring abandonment	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Soil sampling and boring abandonment [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Overhead/buried utilities (continued)	• For other overhead or in-workplace utilities, workers must be instructed to use care in working under or around utilities to avoid hot surfaces, pressurized gases or air, leaking pipelines, and discharging steam or hot liquids, and must work to prevent accidental contact or damage. • Overhead utilities should be considered live until determined otherwise • All underground utilities must be clearly marked before beginning work • No borings shall be made within a 4 foot "Buffer Zone" of any utility marking
	Exposure to contaminants	• To the extent feasible, limit contact with subsurface materials • Wear chemical resistant gloves (nitrile inner and outer) when handling soil samples • SSHO shall conduct breathing zone monitoring for volatile organic compounds (VOCs) with a photoionization detector (PID)/flame ionization detector (FID) if any odors or visible soil staining are encountered (SSHO may require an upgrade in PPE or modification to work based on monitoring results) • Wash hands and face prior to eating, drinking, or smoking after handling potentially contaminated materials
	Spills/residue material	• Have absorbent materials available to control possible spills or leaks
	Electrical Hazards (Extension cords, electrical equipment, temporary lighting, if encountered)	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter outlets may be used
	Noise	• Drill Rig operation may result in high noise levels • Appropriate hearing protection with a NRR >26 shall be worn while operating the drill rig
	Pinch points	• Use appropriate PPE (leather gloves) when handling tools

AHA-05 (continued)

Activity	Potential Hazard(s)	Control Measures
Soil sampling and boring abandonment [NOTE: The hazards and control measures presented in AHA 01 are applicable to all phases of the project]	Cut hazards	• Use care when handling glassware • Do not reach "blindly" into sample container cooler
	Dust	• Use wet methods to prevent dust generation
Preparing shipping container after sampling	Heavy lifting (heavy from ice in sample shipping containers)	• Do not overload shipping containers with ice and with samples • Use proper lifting techniques • Wear disposable gloves to avoid contact

Equipment Used	Inspection Requirements	Training Requirements
Modified Level D PPE (Level C, if SSHO determines needed) First Aid Kits Eyewash Fire Extinguishers Direct Push Technology (DPT) drill rig	Employees inspect their own PPE. Weekly inspections will be performed on fire extinguishers. Weekly inspections will be performed on first aid kits and eyewash. Informal daily inspections are to be conducted by the SSHO. Formal weekly safety inspections are to be conducted and documented on field inspection form by the SSHO.	Personnel have read and understand the HASP, hospital route map, SDSs, and AHAs At least two designated individuals onsite will have current CPR and First Aid training Operator of the DPT rig must be trained and experienced

AHA – 06

Task: Monitoring Well Installation	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Monitoring Well Installation [Note: Hazards and recommended controls from AHA-01 - Mobilization/ Demobilization/Site Preparation apply to these activities too]	Drill Rig Hazards	• Drill rig is to be operated and maintained by qualified operators • A Drill Rig Inspection Checklist (in Attachment 2 of the HASP) should be completed to ensure that the rig is operating properly (the inspection will include fittings, cables, pins, connections, lubrication points, controls, emergency stops, etc.) • To the extent possible, the terrain should be level and the condition of the ground such that unexpected movement of the rig is unlikely • Stabilize the rig prior to boring in accordance with manufacturer's recommendations • Wear required PPE (hard hat, safety glasses, work gloves, ear muffs or plugs, steel toe work boots), ensure loose clothing is secured • Maintain good housekeeping on and around drill rig • Keep hands, fingers, and other body parts clear of all moving machinery; ensure machine guards are in place while in operation
	Exposure to contaminants	• To the extent feasible, limit contact with subsurface materials • Wear chemical resistant gloves (nitrile inner and outer) when handling soil and groundwater samples • SSHO will conduct breathing zone monitoring for volatile organic compounds (VOCs) with a photoionization detector (PID)/flame ionization detector (FID) if any odors or visible soil staining are encountered (SSHO may require an upgrade in PPE or modification to work based on monitoring results) • Wash hands and face prior to eating, drinking, or smoking after handling potentially contaminated materials
	Noise	• Drill Rig operation may result in high noise levels • Appropriate hearing protection with a NRR >26 will be worn while operating the drill rig

AHA-06 (continued)

Activity	Potential Hazard(s)	Control Measures
Monitoring Well Installation (continued) (NOTE: Hazards and recommended controls from AHA -01 -Mobilization/ Demobilization/Site Preparation apply)	Overhead/buried utilities Overhead/buried utilities (continued)	• Work activity adjacent to overhead electric power lines will not be initiated until a survey has been conducted to ascertain the safe clearance distance from energized lines. • Refer to the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385-1-1, 2014) for a complete description of procedures required when working at a location adjacent to overhead power lines. • The minimum required clearance distances from energized overhead electric lines are provided below.

Nominal System Voltage	Minimum Rated Clearance
0 to 50 kilovolts (kV)	10 feet (ft) (3 meters [m])
51 to 200 kV	15 ft (4.6 m)
201 to 350 kV	20 ft (6 m)
351 to 500 kV	25 ft) (7.6 m)
501 to 650 kV	30 ft (9.1 m)
651 to 800 kV	35 ft (10.7 m)
801 to 950 kV	40 ft (12.2 m)
951 to 1,100 kV	45 ft (13.7 m)

- For other overhead or in-workplace utilities, workers must be instructed to use care in working under or around utilities to avoid hot surfaces, pressurized gases or air, leaking pipelines, and discharging steam or hot liquids, and must work to prevent accidental contact or damage.
- Overhead utilities should be considered live until determined otherwise
- All underground utilities must be clearly marked before beginning work
- No borings will be made within a 4 foot “Buffer Zone” of any utility marking

AHA - 06 (continued)

Activity	Potential Hazards	Recommended Controls
Monitoring Well Installation (continued)	Spills/residue material	• Have absorbent materials available to control possible spills or leaks
	Heavy lifting (sample shipping containers)	• Use proper lifting techniques
	Electrical Hazards (Extension cords, electrical equipment, temporary lighting, if encountered)	• Equipment must be inspected prior to use and must be in good condition • The use of extension cords or other portable electrical connections or devices that are not rated for use in wet environments is strictly prohibited • Only ground fault circuit interrupter outlets may be used
	Pinch points	• Utilize appropriate PPE (leather gloves) when handling well casings and tools
	Dust	• Use care when filling bore holes and using materials (sand, bentonite, Portland cement) to prevent dust generation • Position body in an upwind location from materials while mixing and pouring • Use wet methods to prevent dust generation
	Cut hazards	• Use care when handling glassware • Do not reach “blindly” into sample container cooler
Safety Equipment Used	**Inspection Requirements**	**Training Requirements**
Modified Level D PPE (upgrades to level C with respiratory protection worn, only as needed) First Aid Kit and Eyewash Fire Extinguisher Environmental Air Monitoring Equipment	Informal daily work area inspections to be conducted by the SSHO Formal weekly safety inspections will be conducted and documented. Weekly inspection of first aid kit and eye wash. Perform Calibrations in accordance with equipment manual	Site personnel received site specific safety indoctrination before starting site activities Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Only experienced personnel will operate equipment The SSHO and at least one more person onsite will have CPR and First Aid, and Blood borne Pathogens training

AHA – 07

Task: Excavation/Backfill/Site Restoration	**Bhate Project Number:** NWO1312.0150.001.0001.03	
Minimum Personal Protective Equipment (PPE): Minimum Level D PPE (Long pants, shirts with minimum 4" sleeve, safety boots/insulated boots, safety glasses, hard hat when overhead hazards, leather/insulated work gloves). Chemical impervious gloves (nitrile inner and outer) and hearing protection with a noise reduction rating >26, as needed.	**Location:** LHAAP, Karnack, Texas	
	Analysis Approved by: Sally S. Smith, CIH, CSP, CHMM, CPEA	**Date:** May 2018

Activity	Potential Hazard(s)	Control Measures
Excavations/Backfill/Site Restoration, as needed	Excavation and trenching hazards include but are not limited to Cave-in, equipment pinch point/crushing hazards, atmospheric hazards, engulfment, utilities, etc.	• Keep workers away from digging equipment and never allow workers in an excavation when equipment is in use. • Keep workers from getting between equipment in use and other obstacles and machinery that can cause crushing hazards. • Keep equipment and the excavated dirt back >2 feet from the edge of the excavation. • Have a competent person conduct daily inspections and correct any hazards before workers enter a trench or excavation. Soils analysis and inspections must be documented on the appropriate forms on a daily basis. • Provide workers a way to get into and out of a trench or excavation > 4 feet deep such as ladders and ramps. They must be within 25 feet of the worker. • For excavations and utility trenches over 5 feet deep where employees must enter, use shoring, shields (trench boxes), benching, or slope back the sides. Unless soil analysis has been completed, the earth's slope must be at least 1½ feet horizontal to 1 foot vertical (34°). • Keep water out of trenches with a pump or drainage system, and inspect the area for soil movement and potential cave-ins. • Keep drivers in the cab and workers away from dump trucks when dirt and other debris are being loaded into them. Don't allow workers under any load and train them to stay clear of the backs of vehicles. • Air monitoring must be conducted prior to entering a trench >4 feet deep; oxygen levels must be between 19.5 and 23.5 % oxygen; lower explosion limit must be less than <10%; Carbon Monoxide levels must be less than < 25 ppm. • Inspect the trench regularly for changes in the stability of the earth (water, cracks, vibrations, spoils pile). Stop work if any potential for cave-in develops and fix the problem before work starts again. • All trenches must be properly barricade (safety fencing) and marked ("Danger – Open Pit" or "Danger – Open Trench"). • Travel pathways should be a minimum of 6 feet from an open excavation or trench and the possibility of needing • Arrange for overhead lighting if night work is anticipated and use lighting systems for visibility and hazard identification at night as necessary. • Provide lighting for hazard identification to prevent pedestrians and vehicles from entering work area at night or when unattended.

AHA-07 (continued)

Safety Equipment Used	Inspection Requirements	Training Requirements
Modified Level D PPE (upgrades to level C with respiratory protection worn, only as needed) First Aid Kit and Eyewash Fire Extinguisher	Informal daily work area inspections to be conducted by the SSHO Formal weekly safety inspections will be conducted and documented. Weekly inspection of first aid kit and eye wash.	Site personnel received site specific safety indoctrination before starting site activities Site personnel have read and understand the HASP Site personnel possess all of the required training as specified in the HASP Only experienced personnel will operate equipment The SSHO and at least one more person onsite will have CPR and First Aid and Bloodborne Pathogens training When needed, employees involved in excavation work will have appropriate OSHA 29 CFR Part 1926 Subpart P training and a competent person will be present

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	**Mobilization/Demobilization**	Overall Risk Assessment Code (RAC) (Use highest code)			**L**
	SIGNATURES	Activity #		AHA #	

CLIENT:	
NAME & DATE ACCEPTED BY GDA:	
CONTRACT NUMBER:	
TASK ORDER/DELIVERY #:	
PRIME CONTRACTOR:	
SUBCONTRACTOR:	**Robotics Fabrication, Inc.**
DATE OF PREPARATORY MEETING:	
DATE OF INITIAL INSPECTION:	
CONTRACTOR COMPETENT PERSON:	
SITE SAFETY and HEALTH OFFICER	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)
E = EXTREMELY HIGH		Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity
H = HIGH RISK		**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place
M = MODERATE RISK		
L = LOW RISK		**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.

Job Steps	Hazards	Controls	RAC
Mobilization/Demobilization	Adverse weather	• Check internet, local TV weather or radio channels for daily forecasts and plan mobilization/demobilization activities accordingly. • Frequently observe the skyline for rain squalls and thunder storms systems that may develop. • Bring clothing suitable for anticipated daily weather conditions. • Shut down operations during heavy rain/lightning events or high wind conditions. For storms producing lightning, seek safe haven in a grounded structure or rubber wheeled vehicle. • Implement the 30-30 rule. Do not seek refuge under trees during electrical or high wind storm events. • If the weather dictates, pull off the road in a safe location and wait for safer conditions. • Do not use telephones during electrical storms, except in the case of emergency.	**L**

	Driving	• Always use a seat belt while operating a vehicle during mobilization/demobilization. • Always observe posted speed limits, traffic signs and signals. • Never use a cell phone or two-way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Do not operate a vehicle if you are tired, or under the influence of alcohol or prescription medication.	**L**
	Loading/Unloading Heavy Equipment	• Robotic heavy equipment shall only be operated by personnel qualified by prior training or experience. • Perform daily maintenance and inspections on operating equipment. • Ensure that all equipment is secured prior to mobilization/demobilization operations. • Robotic heavy equipment will be provided with necessary safety equipment including backup warning lights and audible alarms. • Sufficient separation between ground support personnel and any operating heavy equipment must be maintained. • All loads will be secured in a way that prevents shifting or movement during mobilization/demobilization.	**L**
	Set Up Command Post	• Command post trailer will be towed by the service truck to a location outside of the exclusion area that is suitable for command and control, as directed by ATPIM. • The command post trailer will be stationed on level ground, wheels will be chocked and the trailer will be unhooked from the service vehicle.	
	Cuts/abrasions	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp/cut edges, shrapnel, or hand tools. • Do not use razor knives, unless they are a “safety knife”. • Wear sturdy work boots to protect against cuts by sharp objects. • Do not approach operating heavy equipment until the machine is shut down. • Identify all pinch points. • Never place hands between rigging apparatus. • Use sleever bars and/or crow bars to aid with separating bunched up materials, as needed. Do not place feet in a pinch point.	
	Slips/trips/falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet surfaces, polyethylene sheeting, and where unprotected holes, drainage areas, rip rap, utilities, and ground protrusions. Observe, mark and avoid any of these identified conditions. • Use sturdy hard-toe work boots with sufficient ankle support.	

		• Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Remove and store materials from pathways and commonly traveled areas as soon as possible. • Three points of contact when accessing exiting equipment. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385.	
	Spill prevention	• OSHA approved safety fuel cans will have secondary containment. • Ensure that spill control and spill clean-up and materials are on hand before initiating any heavy equipment or fueling operations.	
	Biological	• Observe ground surfaces, enclosed structures, and surrounding vegetation for hazardous plants, insects, snakes, and spiders. • Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. • Tick prevention measures: – Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into/taped to boots. – Spray only outside of clothing with permethrin or permanone and spray skin with DEET or other appropriate repellant. – Check yourself frequently for ticks. • Where exposure to ticks is verified, personnel shall consider wearing “bug-out” suits to minimize potential exposures to ticks or other biting insects (i.e., chiggers). • Frequently check body and clothing for ticks, chiggers, spiders. • Where exposure to poisonous plants that have oils, berries or needle-like projects could cause skin irritations, infections or allergic reactions use disposable coveralls for protection. • First aid kits and a Bloodborne Pathogens Protection Kit shall be immediately available at the site. • Use universal precautions when dealing with materials or situations where there is a potential for bloodborne pathogens.	
	Heat/Cold Stress	**Heat Stress** • Perform physiological monitoring according to the APP/SSHP and/or Employee Handbook. • Become familiar with signs and symptoms of heat stress. • Drink 16 oz. of water prior to beginning work. • Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities).	

		• Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency. • Conduct strenuous field activities in the early morning or evening and rotate shifts of workers, if possible. • Whenever possible, avoid direct sun, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods. • Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal). • Maintain good hygiene standards by frequently changing clothing and showering. • Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSHO to avoid progression of heat-related illness. • To counteract the onset of heat stress symptoms, a work-break regimen must be established during the executed work. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.* 2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.* 4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!* **Cold Stress** • Be aware of the symptoms of cold-related disorders.	

		• Wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSO to avoid progression of cold-related illness. • Implement work/rest regimen as necessary. • Observe one another for initial signs of cold-related disorders. • Obtain and review weather forecast— be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation. •	

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
• Fire extinguisher (when using fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • First Aid/BBP/CPR shield • Spill Kit • Communication devices • Barricades and signage	• Competent robotic operator certification • Fire extinguisher training • 1st Aid/CPR 1st Aid/CPR (2 per site) • Site Supervisors training • Training and medical surveillance per 29CFR1910.120 • UXO TIII/UXO TII/IXO TI (DDESB TP-18) • UXO Avoidance for non-UXO personnel • Site-specific MEC training will be presented to all site personnel • PPE training • All site personnel will have current HAZWOPER training.	• Monthly fire extinguisher inspection by competent employee, yearly inspection by licensed company. Monthly inspection tag should be attached. • Visual Inspections of designated work areas identify and address hazardous/MR conditions. • Emergency Response equipment Inspections (Fire Extinguishers, Eye wash First Aid/CPR etc.) • Equipment inspected daily prior to use • PPE inspected daily prior to use • Communications equipment checked daily prior to use

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	**Cutting and Welding**	Overall Risk Assessment Code (RAC) (Use highest code)			**M**
	SIGNATURES	Activity #		AHA #	

CLIENT:	
NAME & DATE ACCEPTED BY GDA:	
CONTRACT NUMBER:	
TASK ORDER/DELIVERY #:	
PRIME CONTRACTOR:	
SUBCONTRACTOR:	**Robotics Fabrication, Inc.**
DATE OF PREPARATORY MEETING:	
DATE OF INITIAL INSPECTION:	
CONTRACTOR COMPETENT PERSON:	
SITE SAFETY and HEALTH OFFICER	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)
E = EXTREMELY HIGH	🟥	Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity
H = HIGH RISK	🟧	**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place
M = MODERATE RISK	🟨	
L = LOW RISK	🟩	**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.

Job Steps	Hazards	Controls	RAC
Repair Operations – Cutting & Welding	Fire and Burns	• When practical, the object to be welded, cut, or heated should be moved to a designated safe location away from flammable liquids and other combustibles. • If the object cannot be moved, positive means must be taken to confine the heat, sparks, and slag. • A 20lb, ABC dry chemical extinguisher (or equivalent) must be immediately available in the work area and must be maintained in a state of readiness for instant use. • Garbage and trash shall not be allowed to accumulate on the premises, as it may be ignited by the sparks or slag. • A fire watch must be maintained at least 30 minutes after the hot work is completed. • Welding/cutting operations shall be performed by trained, certified workers.	**M**

	Eye damage, electric shock, cuts and burns	• During welding/cutting operations, proper welding gloves and a full-face, UV-ray protective shield shall be worn to prevent injuries to the operator. • All electrical cords shall be inspected and in good working condition prior to use (no missing ground pins, no damaged cords, or frayed wires evident). • All small tools shall be inspected prior to use and found to be in good working order prior to use.	**M**
	Adverse weather	• Check internet, local TV weather or radio channels for daily forecasts and plan daily work activities accordingly. • Frequently observe the skyline for rain squalls and thunder storms systems that may develop. • Bring clothing suitable for anticipated daily weather conditions. • Shut down operations during heavy rain/lightning events or high wind conditions. For storms producing lightning, seek safe haven in a grounded structure or rubber vehicle. • Implement 30 – 30 rule. Do not seek refuge under trees during electrical or high wind storm events. • Do not use telephones during electrical storms, except in the case of emergency.	**L**
	Biological	• Observe ground surfaces, enclosed structures, and surrounding vegetation for hazardous plants, insects, snakes, and spiders. • Prior to starting welding activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. • Tick prevention measures: – Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into/taped to boots. – Spray only outside of clothing with permethrin or permanone and spray skin with DEET or other appropriate repellant. – Check yourself frequently for ticks. • Where exposure to ticks is verified, personnel shall consider wearing “bug-out” suits to minimize potential exposures to ticks or other biting insects (i.e., chiggers). • Frequently check body and clothing for ticks, chiggers, spiders. • Where exposure to poisonous plants that have oils, berries or needle-like projects could cause skin irritations, infections or allergic reactions use disposable coveralls for protection. • First aid kits and a Bloodborne Pathogens Protection Kit shall be immediately available at the site. • Use universal precautions when dealing with materials or situations where there is a potential for bloodborne pathogens.	**L**

	Fire prevention	- Use only metal OHSA approved safety cans for storage and transfer of fuel. - Secondary containment will be provided for all OSHA approved fuel cans. - Use funnels and nozzles during fueling operations. - No temporary fuel tanks will be used on-site. Support vehicle with fuel cell will refuel off site. No smoking is allowed during refueling operations. - Do not operate welder in tall grass, dry vegetation or leaves. - Appropriately sized, easily accessible ABC fire extinguisher in work area. - Fire extinguishers must be inspected monthly (inspection tag) and have an annual maintenance/inspection certification (tag) attached to the extinguisher. - Only smoke in designated areas. Designated area must be free of combustible/flammable materials.	**M**
	Heat/Cold Stress	**<u>Heat Stress</u>** - Perform physiological monitoring according to the APP/SSHP and/or Employee Handbook. - Become familiar with signs and symptoms of heat stress. - Drink 16 oz. of water prior to beginning work. - Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities). - Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency. - Conduct strenuous field activities in the early morning or evening and rotate shifts of workers, if possible. - Whenever possible, avoid direct sun, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods. - Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal). - Maintain good hygiene standards by frequently changing clothing and showering. - Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSHO to avoid progression of heat-related illness. - To counteract the onset of heat stress symptoms, a work-break regimen must be established during the executed work. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat.	**L**

		Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete. 2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.* 4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!* **Cold Stress** • Be aware of the symptoms of cold-related disorders. • Wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSO to avoid progression of cold-related illness. • Implement work/rest regimen as necessary. • Observe one another for initial signs of cold-related disorders. • Obtain and review weather forecast— be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.	
	Manual lifting	• TLI or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities, especially lifting operation involving repetitive motions. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. Use heavy equipment to transfer heavy or awkward loads wherever possible. Have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Do not attempt to manually lift objects that should otherwise be lifted with heavy equipment.	**M**

		• Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear before the lift. Avoid carrying heavy objects above shoulder level.	
	Spill prevention	• OSHA approved safety fuel cans will have secondary containment. • Ensure that spill control and spill clean-up and materials are on hand before initiating any heavy equipment or fueling operations.	**L**
	Slips/trips/falls/housekeeping	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet surfaces, polyethylene sheeting, and where unprotected holes, drainage areas, rip rap, utilities, and ground protrusions. Observe, mark and avoid any of these identified conditions. • Use sturdy hard-toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Remove and store materials from pathways and commonly traveled areas as soon as possible. • Three points of contact when accessing exiting equipment. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385.	**L**

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
• 20lb, ABC dry chemical extinguisher • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • First Aid/BBP/CPR shield • Spill Kit • Communication devices • Welding helmet and leather outerware • Gloves	• Certified welding personnel • Certified Fire Watch personnel • Fire extinguisher training • Review APP/SSHP for new site personnel • 1st Aid/CPR 1st Aid/CPR (2 per site) • Training and medical surveillance per 29CFR1910.120 • PPE training • All site personnel will have current HAZWOPER training	• Monthly fire extinguisher inspection by competent employee, yearly inspection by licensed company. Monthly inspection tag should be attached • Visual Inspections of designated work areas identify and address hazards • Prior to each use, inspect welding equipment. • Emergency Response equipment Inspections (Fire Extinguishers, Eye wash First Aid/CPR etc.) • Equipment inspected daily prior to use • PPE inspected daily prior to use • Communications equipment checked daily prior to use

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	**Robotic Vegetation Removal**	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
	SIGNATURES	Activity #	AHA #

CLIENT:	
NAME & DATE ACCEPTED BY GDA:	
CONTRACT NUMBER:	
TASK ORDER/DELIVERY #:	
PRIME CONTRACTOR:	
SUBCONTRACTOR:	**Robotics Fabrication, Inc.**
DATE OF PREPARATORY MEETING:	
DATE OF INITIAL INSPECTION:	
CONTRACTOR COMPETENT PERSON:	
SITE SAFETY and HEALTH OFFICER	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)
E = EXTREMELY HIGH	🟥	Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity
H = HIGH RISK	🟧	**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place
M = MODERATE RISK	🟨	
L = LOW RISK	🟩	**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.

Job Steps	Hazards	Controls	RAC
Removal of Malfunctioning Equipment from Exclusion Area	MEC/MPPEH avoidance	• Entry by RFI Robotic Operators to evaluate and remove malfunctioning robotic equipment from the Exclusion Area will be conducted under the direction of TLI UXO qualified personnel as required by the Explosives Safety Submission (ESS)/Explosives Site Plan (ESP). All personnel entering the Exclusion Area to evaluate and remove malfunctioning robotic equipment will precisely follow operational and Emergency Notification procedures in the event live or potentially live MEC/MPPEH is encountered. • Anomaly Avoidance support must be provided to non-UXO qualified personnel performing tasks within a munitions response site as required by the ESS/ESP. • Personnel who are not UXO-qualified WILL NOT touch, move, or otherwise disturb potential MEC items. • • In the event a potential MPPEH/MEC related discovery were to occur on-site by non-UXO qualified personnel, all work would cease and any	**M**

		operating heavy equipment will be shut-down and secured and the flowing procedures shall be executed: **1. Immediately Stop Work (RECOGNIZE):** *Do not disturb or move a suspect MEC/MPPEH hazard. Only trained UXO Technicians are authorized to investigate potential MEC/MPPEH hazards. Make sure that cell phones/two way radios or other electro-magnetic sources are not engaged in the area of the suspect item.* **2. Secure area/location where the UXO/MPPEH/MEC item is discovered (RETREAT):** *Stop and secure any operating equipment to the extent possible. Mark the general area/location of the UXO/MPPEH/MEC hazard with tape, colored cloth, or colored ribbon. Avoid using markers that penetrate the ground surface.* **3. Immediately make notification to SUXO or client EOD (REPORT):** Once area has been evacuated, appropriate notifications shall be made immediately to the site SUXOS, UXOSO/QCS, supervisor, project manager and Client. Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features. 4**. Operations cannot resume until such safeguards and approvals are in place to safely continue the assigned work, in accordance with ESS approvals to do so.**	
	Driving	• The service truck will only enter the Exclusion Area under escort by TLI UXO personnel. • TLI UXO personnel will clear a path wide enough for the service truck and/or the other operable robotic mulcher to access the malfunctioning equipment. • The path will be marked to use for egress by the service truck, and in the event that the malfunctioning equipment requires towing to the command post for repairs. • In the event that repairs will be made to the vehicle at the downed location, TLI UXO personnel will clear a safe working area around the malfunctioning equipment that is no less than 10 ft. from the equipment, or as determined by the TLI UXO personnel. • Always use a seat belt while driving on military/government facilities. • Always observe posted speed limits, traffic signs and signals. • Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Follow TLI cell phone and driving policy.	**M**

		- No manned vehicles are allowed in the exclusion zone during robotic operations.	
	Adverse weather	- Check internet, local TV weather or radio channels for daily forecasts and plan daily work activities accordingly. - Frequently observe the skyline for rain squalls and thunder storms systems that may develop. - Bring clothing suitable for anticipated daily weather conditions. - Shut down operations during heavy rain/lightning events or high wind conditions. For storms producing lightning, seek safe haven in a grounded structure or rubber vehicle. - Implement 30 – 30 rule. Do not seek refuge under trees during electrical or high wind storm events. - Do not use telephones during electrical storms, except in the case of emergency.	**L**
	Biological	- Observe ground surfaces, enclosed structures, and surrounding vegetation for hazardous plants, insects, snakes, and spiders. - Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. - Tick prevention measures: – Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into/taped to boots. – Spray only outside of clothing with permethrin or permanone and spray skin with DEET or other appropriate repellant. – Check yourself frequently for ticks. - Where exposure to ticks is verified, personnel shall consider wearing "bug-out" suits to minimize potential exposures to ticks or other biting insects (i.e., chiggers). - Frequently check body and clothing for ticks, chiggers, spiders. - Where exposure to poisonous plants that have oils, berries or needle-like projects could cause skin irritations, infections or allergic reactions use disposable coveralls for protection. - First aid kits and a Bloodborne Pathogens Protection Kit shall be immediately available at the site. - Use universal precautions when dealing with materials or situations where there is a potential for bloodborne pathogens.	**L**

	Cuts/abrasions	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp/cut edges, shrapnel, or hand tools. • Do not use razor knives, unless they are a "safety knife". • Wear sturdy work boots to protect against cuts by sharp objects. • Do not approach operating heavy equipment until the machine is shut down. • Identify all pinch points. • Never place hands between rigging apparatus. • Use sleever bars and/or crow bars to aid with separating bunched up materials, as needed. • Do not place feet in a pinch point.	**M**
	Heat/Cold Stress	**<u>Heat Stress</u>** • Perform physiological monitoring according to the APP/SSHP and/or Employee Handbook. • Become familiar with signs and symptoms of heat stress. • Drink 16 oz. of water prior to beginning work. • Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities). • Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency. • Conduct strenuous field activities in the early morning or evening and rotate shifts of workers, if possible. • Whenever possible, avoid direct sun, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods. • Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal). • Maintain good hygiene standards by frequently changing clothing and showering. • Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSHO to avoid progression of heat-related illness. • To counteract the onset of heat stress symptoms, a work-break regimen must be established during the executed work. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.*	**L**

		2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.* 4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!* **<u>Cold Stress</u>** • Be aware of the symptoms of cold-related disorders. • Wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSO to avoid progression of cold-related illness. • Implement work/rest regimen as necessary. • Observe one another for initial signs of cold-related disorders. • Obtain and review weather forecast— be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.	
	Manual lifting	• TLI or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities, especially lifting operation involving repetitive motions. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. Use heavy equipment to transfer heavy or awkward loads wherever possible. Have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Do not attempt to manually lift objects that should otherwise be lifted with heavy equipment. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear before the lift. Avoid carrying heavy objects above shoulder level.	**L**

	MEC/MPPEH Explosion and Injury	• Only qualified UXO personnel will investigate and handle potential MEC. • Robotics heavy equipment will be shut down during investigation of potential MEC, and operations will not resume until authorized to proceed by qualified UXO personnel.	**L**
	Spill prevention	• OSHA approved safety fuel cans will have secondary containment.. • Ensure that spill control and spill clean-up and materials are on hand before initiating any heavy equipment or fueling operations.	**L**
	Slips/trips/falls/housekeeping	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet surfaces, polyethylene sheeting, and where unprotected holes, drainage areas, rip rap, utilities, and ground protrusions. Observe, mark and avoid any of these identified conditions. • Use sturdy hard-toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Remove and store materials from pathways and commonly traveled areas as soon as possible. • Three points of contact when accessing exiting equipment. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385.	**L**
	Working Around Robotic Heavy Equipment	• Robotic heavy equipment will be shut down and secured when personnel must be in the area of operating heavy equipment.	**L**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
• Fire extinguisher (when using fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • First Aid/BBP/CPR shield • Spill Kit • Communication devices • MEC avoidance equipment (Schonstedt) • Pin flags	• Competent robotic maintenance and repair operator • Fire extinguisher training • Review APP/SSHP for new site personnel • 1st Aid/CPR 1st Aid/CPR (2 per site) • Site Supervisors training • Training and medical surveillance per 29CFR1910.120 • UXO TIII/UXO TII/IXO TI (DDESB TP-18) • UXO Avoidance for non-UXO personnel • Site-specific MEC training will be presented to all site personnel • PPE training • All site personnel will have current HAZWOPER training	• Monthly fire extinguisher inspection by competent employee, yearly inspection by licensed company. Monthly inspection tag should be attached • Visual Inspections of designated work areas identify and address hazardous/MR conditions • Emergency Response equipment Inspections (Fire Extinguishers, Eye wash First Aid/CPR etc.) • PPE inspected daily prior to use • Communications equipment checked daily prior to use

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	**Robotic Heavy Equipment Operations**	Overall Risk Assessment Code (RAC) (Use highest code)			**L**
	SIGNATURES	Activity #		AHA #	

CLIENT:	
NAME & DATE ACCEPTED BY GDA:	
CONTRACT NUMBER:	
TASK ORDER/DELIVERY #:	
PRIME CONTRACTOR:	
SUBCONTRACTOR:	**Robotics Fabrication, Inc.**
DATE OF PREPARATORY MEETING:	
DATE OF INITIAL INSPECTION:	
CONTRACTOR COMPETENT PERSON:	
SITE SAFETY and HEALTH OFFICER	

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)

E = EXTREMELY HIGH	🟥
H = HIGH RISK	🟧
M = MODERATE RISK	🟨
L = LOW RISK	🟩

Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)

Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place

"Probability" is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.

Job Steps	Hazards	Controls	RAC
Robotic Heavy Equipment Set Up, Operations, Maintenance and Tear Down	Adverse weather	• Check internet, local TV weather or radio channels for daily forecasts and plan daily work activities accordingly. • Frequently observe the skyline for rain squalls and thunder storms systems that may develop. • Bring clothing suitable for anticipated daily weather conditions. • Shut down operations during heavy rain/lightning events or high wind conditions. For storms producing lightning, seek safe haven in a grounded structure or rubber vehicle. • Implement 30 – 30 rule. Do not seek refuge under trees during electrical or high wind storm events. • Do not use telephones during electrical storms, except in the case of emergency.	**L**

	Biological	• Observe ground surfaces, enclosed structures, and surrounding vegetation for hazardous plants, insects, snakes, and spiders. • Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. • Tick prevention measures: – Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into/taped to boots. – Spray only outside of clothing with permethrin or permanone and spray skin with DEET or other appropriate repellant. – Check yourself frequently for ticks. • Where exposure to ticks is verified, personnel shall consider wearing "bug-out" suits to minimize potential exposures to ticks or other biting insects (i.e., chiggers). • Frequently check body and clothing for ticks, chiggers, spiders. • Where exposure to poisonous plants that have oils, berries or needle-like projects could cause skin irritations, infections or allergic reactions use disposable coveralls for protection. • First aid kits and a Bloodborne Pathogens Protection Kit shall be immediately available at the site. • Use universal precautions when dealing with materials or situations where there is a potential for bloodborne pathogens.	**L**
	Cuts/abrasions	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp/cut edges, shrapnel, or hand tools. • Do not use razor knives, unless they are a "safety knife". • Wear sturdy work boots to protect against cuts by sharp. • Do not approach operating heavy equipment until eye contact w/operator obtained and machine is placed in negative energy w/operators hands off of controls. • Identify all pinch points. • Never place hands between rigging apparatus. • Use sleever bars and/or crow bars to aid with separating bunched up materials, as needed. • Do not place feet in a pinch point.	**M**
	Driving	• Always use a seat belt while driving on military/government facilities. • Always observe posted speed limits, traffic signs and signals. • Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Follow TLI cell phone and driving policy. • No manned vehicles are allowed in the exclusion zone during robotic operations.	**L**

	Fire prevention	- Use only metal safety cans for storage and transfer of fuel. - Use funnels and nozzles during fueling operations. - All temporary fuel tanks will have bonding and grounding installed prior to use. - Refueling will be conducted by two people. - No smoking is allowed during refueling operations. - Do not park in tall grass or leave vehicles running. - Appropriately sized, easily accessible ABC fire extinguisher in work area. - Fire extinguishers must be inspected monthly (inspection tag) and have an annual maintenance/inspection certification (tag) attached to the extinguisher. - Only smoke in designated areas. Designated area must be free of combustible/flammable materials.	**L**
	Hand tools	- Technicians shall perform a pre-operational inspection of their equipment. Do not use any equipment that is unsafe. Never use a tool to do a job it was not designed to do. - Use tools in the manner for which they are designed to avoid tool damage and personal injury. - Keep all bystanders out of the work area. - Allow ample space for each employee to work safely - Prevent back injuries and take frequent breaks to avoid ergonomic stress. - Allow the tool to do the work by using a grip light enough to maintain control. - Clear walkways work areas of equipment, tools, vegetation, excavated material and debris. - Mark, identify, or barricade other obstructions. - The employee is responsible for complying with all applicable HS&E training requirements relating to hand and power tool safety and for providing any additional training necessary to complete their tasks safely. - Operate all tools according to the manufacturer’s instructions and within design limitations. - All hand and power tools shall be maintained in a safe condition. - Tools are to be inspected and tested before use—if a tool is found to be defective it is to be tagged “Do Not Use” and removed from service until repaired. - Personal protective equipment, such as gloves, safety glasses, earplugs, and face shields, are to be used when exposed to a hazard from the tool.	**L**

		• Power tools are not to be carried or lowered by the cord or hose • Disconnect tools from energy sources when not in use, before servicing and cleaning, and when changing accessories such as blades, bits, and cutters • Safety guards on tools are to remain installed while the tool is in use and promptly replaced after repair or maintenance has been performed • Tools are to be stored properly, where they will not be damaged or come in contact with hazardous materials • If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications • Only use a knife or blade if it is the best tool for the job, a separate AHA has been developed, and hand protection (e.g. Kevlar gloves) is provided. Cut away from the body. • As alternatives to manual and pistol-grip hand tools that involve work with highly repetitive movement, extended elevation, constrained postures, or positioning of body members (e.g., hand, wrist, arm, shoulder, neck, etc.): – Consider alternative tool design – Improve posture – Select appropriate materials – Organize work—sequencing to prevent muscular skeletal, repetitive motion, and cumulative trauma stressors • Only employees who have been trained in the operation of the particular tool in use shall be allowed to operate a powder-actuated tool—training and certification must be provided to the Safety Coordinator before using the tool.	
	Heat/Cold Stress	**Heat Stress** • Perform physiological monitoring according to the APP/SSHP and/or Employee Handbook. • Become familiar with signs and symptoms of heat stress. • Drink 16 oz. of water prior to beginning work. • Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities). • Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency. • Conduct strenuous field activities in the early morning or evening and rotate shifts of workers, if possible. • Whenever possible, avoid direct sun, which can decrease physical efficiency and increase the probability of heat stress. Take regular	**L**

		breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods. • Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal). • Maintain good hygiene standards by frequently changing clothing and showering. • Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSHO to avoid progression of heat-related illness. • To counteract the onset of heat stress symptoms, a work-break regimen must be established during the executed work. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.* 2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.* 4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!* **Cold Stress** • Be aware of the symptoms of cold-related disorders. • Wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSO to avoid progression of cold-related illness. • Implement work/rest regimen as necessary. • Observe one another for initial signs of cold-related disorders.	

		• Obtain and review weather forecast— be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.	
	Manual lifting	• TLI or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities, especially lifting operation involving repetitive motions. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. Use heavy equipment to transfer heavy or awkward loads wherever possible. Have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Do not attempt to manually lift objects that should otherwise be lifted with heavy equipment. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear before the lift. Avoid carrying heavy objects above shoulder level.	L
	MEC/MPPEH avoidance	• **Provide UXO qualified personnel as required by the Explosives Safety Submission (ESS)/Explosives Site Plan (ESP) and precisely follow operational and Emergency Notification procedures in the event live or potentially live MEC/MPPEH is encountered.** • Anomaly Avoidance support must be provided to non-UXO qualified personnel performing tasks within a munitions response site as required by the Safety Risk Evaluation (SRE) and/or the ESS/ESP. • Personnel who are not UXO-qualified will note the area of concern, and leave the immediate vicinity. They WILL NOT touch, move, or otherwise disturb the item. • Survey crews working in areas that have not previously been surface cleared for MEC will be accompanied by qualified UXO personnel. • Anomaly avoidance procedures must be implemented when driving survey stakes. • In the event a potential MPPEH/MEC related discovery were to occur on-site by non-UXO qualified personnel, all work would cease and any operating heavy equipment will be shut-down and secured and the flowing procedures shall be executed: **1. Immediately Stop Work (RECOGNIZE):** *Do not disturb or move a suspect MEC/MPPEH hazard. Only trained UXO Technicians are authorized to investigate potential MEC/MPPEH hazards. Make sure that cell phones/two way radios or other electro-magnetic sources are not engaged in the area of the suspect item.*	L

		2. Secure area/location where the UXO/MPPEH/MEC item is discovered (RETREAT): *Stop and secure any operating equipment to the extent possible. Mark the general area/location of the UXO/MPPEH/MEC hazard with tape, colored cloth, or colored ribbon. Avoid using markers that penetrate the ground surface.* **3. Immediately make notification to SUXO or client EOD (REPORT):** Once area has been evacuated, appropriate notifications shall be made immediately to the site SUXOS, UXOSO/QCS, supervisor, project manager and Client. Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features. 4**. Operations cannot resume until such safeguards and approvals are in place to safely continue the assigned work, in accordance with ESS approvals to do so.**	
	MEC/MPPEH Explosion and Injury	• Only qualified UXO personnel will investigate and handle potential MEC. • Robotics heavy equipment will be shut down during investigation of potential MEC, and operations will not resume until authorized to proceed by qualified UXO personnel.	**L**
	Spill prevention	• On-site fuel tanks will be doubled walled, vented and comply with NFPA requirements. • Ensure that spill control and spill clean-up and materials are on hand before initiating any heavy equipment or fueling operations.	**L**
	Slips/trips/falls/housekeeping	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet surfaces, polyethylene sheeting, and where unprotected holes, drainage areas, rip rap, utilities, and ground protrusions. Observe, mark and avoid any of these identified conditions. • Use sturdy hard-toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Remove and store materials from pathways and commonly traveled areas as soon as possible. • Three points of contact when accessing exiting equipment. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385.	**L**
	Striking Buried Utilities or Unknown Objects	• Prior to digging contact utility locator to mark utility location. Submit utility locate information to TLI prior to excavation for review. • At site quality control meetings utility locate documentation will be reviewed with TLI, the SQC System Manager, the safety coordinator and the excavation crew. A site walk will be performed upon	**L**

		completing paperwork review to visually inspect utility locate markings and discuss means and methods of excavation. At this time photo documentation of utility markings will be collected. • Obtain utility diagrams for the facility. • Hand dig around identified utilities (within 5'). • Protect and preserve the markings of approximate locations of facilities until the markings are no longer required. If the markings of utility locations are destroyed or removed before excavation commences or is completed, utilities must be relocated/marked.	
	Traffic control, impact with vehicle	• No vehicles are allowed in the exclusion zone when robotic heavy equipment is operating. • Shut off and secure robotic equipment when not operating. Park on level ground where possible. If parking on an incline, engage parking brake. • Where practicable, park vehicle so that it can serve as a barrier. • Wear safety vests when working near roadways or heavy equipment.	**L**
	Visible lighting	• Perform tasks in daylight hours.	**L**
	Working Around Robotic Heavy Equipment	• Robotic heavy equipment shall only be operated by personnel qualified by prior training or experience. • Perform daily maintenance and inspections on operating equipment. • Ensure that all equipment is turned off and secured prior to conducting maintenance operations. • Use caution around pressurized lines/hoses. Inspect hoses daily for cuts, abrasions and wear. • Ensure that a stable ground surface is available for maintenance operations. • Robotic heavy equipment will be provided with necessary safety equipment including backup warning lights and audible alarms. • Blades and buckets will be lowered to the ground and parking brakes will be set before maintenance is performed. • Robotic heavy equipment will be shut down and secured when personnel must be in the area of operating heavy equipment: • Sufficient separation between ground support personnel and any operating heavy equipment must be maintained.	**L**

	Other	- Verify that EMS services are available and can respond in a prompt manner prior to the start of work. - Ensure adequate site control measures have been implemented per the APP/SSHP. - Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. - Project managers and team leaders to 1) evaluate and ensure worker safety in remote/secluded work areas, 2) confirm if potentially dangerous activities could be occurring in or adjacent to any work areas that may jeopardize worker health and safety and 3) reschedule field activities when potentially dangerous activities are not occurring adjacent to work locations. - Ensure proper two-way communications with workers in remote work areas. Utilize buddy system.	**L**

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
- Fire extinguisher (when using fuel and electrical sources) - Eye wash (small portable type) - Miscellaneous power and manual hand tools. - First Aid/BBP/CPR shield - Spill Kit - Communication devices - MEC avoidance equipment (Schonstedt) - Appropriate geophysical equipment - Barricades and signage	- Competent robotic operator certification - Fire extinguisher training - Review APP/SSHP for new site personnel - 1st Aid/CPR 1st Aid/CPR (2 per site) - Site Supervisors training - Training and medical surveillance per 29CFR1910.120 - UXO TIII/UXO TII/IXO TI (DDESB TP-18) - UXO Avoidance for non-UXO personnel - Site-specific MEC training will be presented to all site personnel - PPE training - Excavation safety training - All site personnel will have current HAZWOPER training	- Monthly fire extinguisher inspection by competent employee, yearly inspection by licensed company. Monthly inspection tag should be attached - Visual Inspections of designated work areas identify and address hazardous/MR conditions - Emergency Response equipment Inspections (Fire Extinguishers, Eye wash First Aid/CPR etc.) - Equipment inspected daily prior to use - PPE inspected daily prior to use - Communications equipment checked daily prior to use

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	**Robotic Screening Operations**	Overall Risk Assessment Code (RAC) (Use highest code)			L
	SIGNATURES	Activity #		AHA #	

CLIENT:	
NAME & DATE ACCEPTED BY GDA:	
CONTRACT NUMBER:	
TASK ORDER/DELIVERY #:	
PRIME CONTRACTOR:	
SUBCONTRACTOR:	**Robotics Fabrication, Inc.**
DATE OF PREPARATORY MEETING:	
DATE OF INITIAL INSPECTION:	
CONTRACTOR COMPETENT PERSON:	
SITE SAFETY and HEALTH OFFICER	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)

E = EXTREMELY HIGH	🟥
H = HIGH RISK	🟧
M = MODERATE RISK	🟨
L = LOW RISK	🟩

Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)

Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place

"Probability" is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.

Job Steps	Hazards	Controls	RAC
Robotic Screening Plant Operations	Vibratory Roto Screens and Conveyors	• Only qualified/authorized personnel shall operate robotic screening plant. • All site personnel will be trained in robotic and manual emergency shutoff/kill switch operation. • Only qualified UXO personnel will investigate and handle potential MEC. • Robotics heavy equipment will be shut down during investigation of potential MEC, and operations will not resume until authorized to proceed by qualified UXO personnel. • Maintain a copy of Manufacturer's manual(s) on site. • Maintenance and repairs will be made IAW manufacturer specifications. • All take up mechanisms (contact with cables, chains, belts) and nip and sheer points shall be guarded. • All screens and guards shall be in place prior to operating. • Perform daily maintenance and inspections on operating equipment.	L

		• Ensure that all equipment is turned off and secured prior to conducting maintenance operations. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385. • Keep areas around loading/unloading points clear of obstructions. • Shut off switches must be tested and witnessed daily.	
	Adverse weather	• Check internet, local TV weather or radio channels for daily forecasts and plan daily work activities accordingly. • Frequently observe the skyline for rain squalls and thunder storms systems that may develop. • Bring clothing suitable for anticipated daily weather conditions. • Shut down operations during heavy rain/lightning events or high wind conditions. For storms producing lightning, seek safe haven in a grounded structure or rubber vehicle. • Implement 30 – 30 rule. Do not seek refuge under trees during electrical or high wind storm events. • Do not use telephones during electrical storms, except in the case of emergency.	**L**
	Biological	• Observe ground surfaces, enclosed structures, and surrounding vegetation for hazardous plants, insects, snakes, and spiders. • Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. • Tick prevention measures: – Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into/taped to boots. – Spray only outside of clothing with permethrin or permanone and spray skin with DEET or other appropriate repellant. – Check yourself frequently for ticks. • Where exposure to ticks is verified, personnel shall consider wearing “bug-out” suits to minimize potential exposures to ticks or other biting insects (i.e., chiggers). • Frequently check body and clothing for ticks, chiggers, spiders. • Where exposure to poisonous plants that have oils, berries or needle-like projects could cause skin irritations, infections or allergic reactions use disposable coveralls for protection. • First aid kits and a Bloodborne Pathogens Protection Kit shall be immediately available at the site. • Use universal precautions when dealing with materials or situations where there is a potential for bloodborne pathogens.	**L**

	Cuts/abrasions	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp/cut edges, shrapnel, or hand tools. • Do not use razor knives, unless they are a "safety knife". • Only use a knife if it is the best tool for the job, and a separate AHA is developed. Follow the TLI knife policy. • Wear sturdy work boots to protect against cuts by sharp. • Do not approach operating heavy equipment until eye contact w/operator obtained and machine is placed in negative energy w/operators hands off of controls. • Identify all pinch points. • Never place hands between rigging apparatus. • Use sleever bars and/or crow bars to aid with separating bunched up materials, as needed. • Do not place feet in a pinch point.	**M**
	Driving	• Always use a seat belt while driving on military/government facilities. • Always observe posted speed limits, traffic signs and signals. • Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Follow TLI cell phone and driving policy. • No manned vehicles are allowed in the exclusion zone during robotic operations.	**L**
	Fire prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • All temporary fuel tanks will have bonding and grounding installed prior to use. • Refueling will be conducted by two people. • No smoking is allowed during refueling operations. • Do not park in tall grass or leave vehicles running. • Appropriately sized, easily accessible ABC fire extinguisher in work area. • Fire extinguishers must be inspected monthly (inspection tag) and have an annual maintenance/inspection certification (tag) attached to the extinguisher. • Only smoke in designated areas. Designated area must be free of combustible/flammable materials.	**L**
	Hand tools	• Technicians shall perform a pre-operational inspection of their equipment. Do not use any equipment that is unsafe. Never use a tool to do a job it was not designed to do. • Use tools in the manner for which they are designed to avoid tool damage and personal injury. • Keep all bystanders out of the work area. • Allow ample space for each employee to work safely	**L**

		• Prevent back injuries and take frequent breaks to avoid ergonomic stress. • Allow the tool to do the work by using a grip light enough to maintain control. • Clear walkways work areas of equipment, tools, vegetation, excavated material and debris. • Mark, identify, or barricade other obstructions. • The employee is responsible for complying with all applicable HS&E training requirements relating to hand and power tool safety and for providing any additional training necessary to complete their tasks safely. • Operate all tools according to the manufacturer's instructions and within design limitations. • All hand and power tools shall be maintained in a safe condition. • Tools are to be inspected and tested before use—if a tool is found to be defective it is to be tagged "Do Not Use" and removed from service until repaired. • Personal protective equipment, such as gloves, safety glasses, earplugs, and face shields, are to be used when exposed to a hazard from the tool. • Power tools are not to be carried or lowered by the cord or hose • Disconnect tools from energy sources when not in use, before servicing and cleaning, and when changing accessories such as blades, bits, and cutters • Safety guards on tools are to remain installed while the tool is in use and promptly replaced after repair or maintenance has been performed • Tools are to be stored properly, where they will not be damaged or come in contact with hazardous materials • If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications • Only use a knife or blade if it is the best tool for the job, a separate AHA has been developed, and hand protection (e.g. Kevlar gloves) is provided. Cut away from the body. • As alternatives to manual and pistol-grip hand tools that involve work with highly repetitive movement, extended elevation, constrained postures, or positioning of body members (e.g., hand, wrist, arm, shoulder, neck, etc.): – Consider alternative tool design – Improve posture – Select appropriate materials	

		– Organize work—sequencing to prevent muscular skeletal, repetitive motion, and cumulative trauma stressors • Only employees who have been trained in the operation of the particular tool in use shall be allowed to operate a powder-actuated tool—training and certification must be provided to the Safety Coordinator before using the tool.	
	Heat/Cold Stress	**<u>Heat Stress</u>** • Perform physiological monitoring according to the APP/SSHP and/or Employee Handbook. • Become familiar with signs and symptoms of heat stress. • Drink 16 oz. of water prior to beginning work. • Acclimate by slowly increasing workloads (e.g., do not begin with extremely demanding activities). • Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency. • Conduct strenuous field activities in the early morning or evening and rotate shifts of workers, if possible. • Whenever possible, avoid direct sun, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods. • Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal). • Maintain good hygiene standards by frequently changing clothing and showering. • Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSHO to avoid progression of heat-related illness. • To counteract the onset of heat stress symptoms, a work-break regimen must be established during the executed work. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.* 2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.*	**L**

		4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!* **Cold Stress** • Be aware of the symptoms of cold-related disorders. • Wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSO to avoid progression of cold-related illness. • Implement work/rest regimen as necessary. • Observe one another for initial signs of cold-related disorders. • Obtain and review weather forecast— be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.	
	Manual lifting	• TLI or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities, especially lifting operation involving repetitive motions. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. Use heavy equipment to transfer heavy or awkward loads wherever possible. Have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Do not attempt to manually lift objects that should otherwise be lifted with heavy equipment. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear before the lift. Avoid carrying heavy objects above shoulder level.	**L**
	MEC/MPPEH avoidance	• **Provide UXO qualified personnel as required by the Explosives Safety Submission (ESS)/Explosives Site Plan (ESP) and precisely follow operational and Emergency Notification procedures in the event live or potentially live MEC/MPPEH is encountered.** • Anomaly Avoidance support must be provided to non-UXO qualified personnel performing tasks within a munitions response site as required by the TLI Safety Risk Evaluation (SRE) and/or the ESS/ESP.	**L**

		- Personnel who are not UXO-qualified will note the area of concern, and leave the immediate vicinity. They WILL NOT touch, move, or otherwise disturb the item. - Survey crews working in areas that have not previously been surface cleared for MEC will be accompanied by qualified UXO personnel. - Anomaly avoidance procedures must be implemented when driving survey stakes. - In the event a potential MPPEH/MEC related discovery were to occur on-site by non-UXO qualified personnel, all work would cease and any operating heavy equipment will be shut-down and secured and the flowing procedures shall be executed: **1. Immediately Stop Work (RECOGNIZE):** *Do not disturb or move a suspect MEC/MPPEH hazard. Only trained UXO Technicians are authorized to investigate potential MEC/MPPEH hazards. Make sure that cell phones/two way radios or other electro-magnetic sources are not engaged in the area of the suspect item.* **2. Secure area/location where the UXO/MPPEH/MEC item is discovered (RETREAT):** *Stop and secure any operating equipment to the extent possible. Mark the general area/location of the UXO/MPPEH/MEC hazard with tape, colored cloth, or colored ribbon. Avoid using markers that penetrate the ground surface.* **3. Immediately make notification to SUXO or client EOD (REPORT):** Once area has been evacuated, appropriate notifications shall be made immediately to the site SUXOS, UXOSO/QCS, supervisor, project manager and Client. Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features. 4**. Operations cannot resume until such safeguards and approvals are in place to safely continue the assigned work, in accordance with ESS approvals to do so.**	
	MEC/MPPEH Explosion and Injury	- Only qualified UXO personnel will investigate and handle potential MEC. - Robotics heavy equipment will be shut down during investigation of potential MEC, and operations will not resume until authorized to proceed by qualified UXO personnel.	**L**
	Spill prevention	- On-site fuel tanks will be doubled walled, vented and comply with NFPA requirements.	**L**

		• Ensure that spill control and spill clean-up and materials are on hand before initiating any heavy equipment or fueling operations.	
	Slips/trips/falls/housekeeping	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet surfaces, polyethylene sheeting, and where unprotected holes, drainage areas, rip rap, utilities, and ground protrusions. Observe, mark and avoid any of these identified conditions. • Use sturdy hard-toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Remove and store materials from pathways and commonly traveled areas as soon as possible. • Three points of contact when accessing exiting equipment. • Portable ladders will be used for equipment maintenance, as required, in accordance with OSHA requirements and EM 385.	**L**
	Striking Buried Utilities or Unknown Objects	• Prior to digging contact utility locator to mark utility location. Submit utility locate information to TLI prior to excavation for review. • At site quality control meetings utility locate documentation will be reviewed with TLI, the SQC System Manager, the safety coordinator and the excavation crew. A site walk will be performed upon completing paperwork review to visually inspect utility locate markings and discuss means and methods of excavation. At this time photo documentation of utility markings will be collected. • Obtain utility diagrams for the facility. • Hand dig around identified utilities (within 5'). • Protect and preserve the markings of approximate locations of facilities until the markings are no longer required. If the markings of utility locations are destroyed or removed before excavation commences or is completed, utilities must be relocated/marked.	**L**
	Traffic control, impact with vehicle	• No vehicles are allowed in the exclusion zone when robotic heavy equipment is operating. • Shut off and secure robotic equipment when not operating. Park on level ground where possible. If parking on an incline, engage parking brake. • Where practicable, park vehicle so that it can serve as a barrier. • Wear safety vests when working near roadways or heavy equipment.	**L**
	Visible lighting	• Perform tasks in daylight hours.	**L**

	Working Around Robotic Heavy Equipment	• Robotic heavy equipment shall only be operated by personnel qualified by prior training or experience. • Perform daily maintenance and inspections on operating equipment. • Ensure that all equipment is turned off and secured prior to conducting maintenance operations. • Use caution around pressurized lines/hoses. Inspect hoses daily for cuts, abrasions and wear. • Ensure that a stable ground surface is available for maintenance operations. • Robotic heavy equipment will be provided with necessary safety equipment including backup warning lights and audible alarms. • Blades and buckets will be lowered to the ground and parking brakes will be set before maintenance is performed. • Robotic heavy equipment will be shut down and secured when personnel must be in the area of operating heavy equipment: • Sufficient separation between ground support personnel and any operating heavy equipment must be maintained.	**L**
	Other	• Verify that EMS services are available and can respond in a prompt manner prior to the start of work. • Ensure adequate site control measures have been implemented per the APP/SSHP. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Project managers and team leaders to 1) evaluate and ensure worker safety in remote/secluded work areas, 2) confirm if potentially dangerous activities could be occurring in or adjacent to any work areas that may jeopardize worker health and safety and 3) reschedule field activities when potentially dangerous activities are not occurring adjacent to work locations. • Ensure proper two-way communications with workers in remote work areas. Utilize buddy system	**L**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
• Fire extinguisher (when using fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • First Aid/BBP/CPR shield • Spill Kit • Communication devices • MEC avoidance equipment (Schonstedt) • Appropriate geophysical equipment • Barricades and signage	• Competent robotic operator certification • Fire extinguisher training • Review APP/SSHP for new site personnel • 1st Aid/CPR 1st Aid/CPR (2 per site). • Site Supervisors training • Training and medical surveillance per 29CFR1910.120 • UXO TIII/UXO TII/IXO TI (DDESB TP-18) • UXO Avoidance for non-UXO personnel • Site-specific MEC training will be presented to all site personnel • PPE training • Excavation safety training • All site personnel will have current HAZWOPER training.	• Monthly fire extinguisher inspection by competent employee, yearly inspection by licensed company. Monthly inspection tag should be attached. • Visual Inspections of designated work areas identify and address hazardous/MR conditions. • Emergency Response equipment Inspections (Fire Extinguishers, Eye wash First Aid/CPR etc.) • Equipment inspected daily prior to use • PPE inspected daily prior to use • Communications equipment checked daily prior to use

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

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Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Inorganic Compounds				
Aluminum	Characteristics: silvery-white, malleable, ductile, odorless metal. Exposure Routes: inhalation, skin, and/or eye contact. Target Organs: eyes, skin, respiratory system. Lower exposure limit (LEL): NA UEL: NA	TWA 10 milligrams per cubic meter (mg/m$^{3)}$ (total) TWA 5 mg/m^3 (respiratory)	TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (respiratory)	
Antimony	Characteristics: silver-white, lustrous, hard, brittle solid; scale-like crystals; or a dark-gray, lustrous powder. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, cardiovascular system. LEL: NA UEL: NA	TWA 0.5 mg/m^3	TWA 0.5 mg/m^3	50 mg/m^3
Arsenic	Characteristics: silver-gray or tin-white, brittle, odorless solid. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: liver, kidneys, skin, lungs, lymphatic system. Cancer Site: lung and lymphatic cancer. LEL: NA UEL: NA	**Ca** ***C*** 0.002 mg/m^3 (15-min)	TWA 0.010 mg/m^3	5 mg/m^3
Asbestos	Characteristics: white or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: respiratory system, eyes. Cancer Site: lung cancer. LEL: NA UEL: NA	Ca Lowest feasible concentration 0.1 fiber/cm3 for fibers >5µm	0.1 fiber/cm3 TWA 1.0 fiber/cm3 Excursion Limit (30 minutes)	Not Established

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Barium (as soluble barium compounds except barium sulfate)	Characteristics: white odorless solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, heart, central nervous system. LEL: NA UEL: NA	TWA 0.5 mg/m^3	TWA 0.5 mg/m^3	50 mg/m^3
Beryllium (and beryllium compounds)	Characteristics: a hard, brittle, gray-white solid. Exposure Routes: inhalation, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. Cancer Site: lung cancer. LEL: NA UEL: NA	**Ca** ***C*** 0.0005 mg/m^3	TWA 0.002 mg/m^3 ***C*** 0.005 mg/m^3 (30-min) with max peak of 0.025 mg/m^3	4 mg/m^3
Cadmium (dust)	Characteristics: silver-white, blue-tinged lustrous, odorless solid. Exposure Routes: inhalation, ingestion. Target Organs: respiratory system, kidneys, prostate, blood. Cancer Site: prostatic and lung cancer. LEL: NA UEL: NA	**Ca**	TWA 0.005 mg/m^3	**Ca** 9 mg/m^3
Chromium, and Chromium (III)	Characteristics: appearance and odor vary depending upon the specific compound. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin. LEL: NA UEL: NA	TWA 0.5 mg/m^3	TWA 1 mg/m^3	250 mg/m^3

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Chromium (VI)	Characteristics: appearance and odor vary depending upon the specific compound. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin. Cancer Site: lungs. LEL: NA UEL: NA	**Ca** TWA 0.001 mg/m^3	TWA 0.005 mg/m^3	**Ca** 15 mg/m^3
Cobalt (dust and fume)	Characteristics: odorless, silver-gray to black solid. Exposure Routes: inhalation, ingestion, skin, and/or eye contact. Target Organs: skin, respiratory system. LEL: NA UEL: NA	TWA 0.05 mg/m^3	TWA 0.1 mg/m^3	20 mg/m^3
Copper (dust)	Characteristics: reddish, lustrous, malleable, odorless solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson’s disease). LEL: NA UEL: NA	TWA 1 mg/m^3	TWA 1 mg/m^3	100 mg/m^3
Lead	Characteristics: a heavy, ductile, soft, gray solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue. LEL: NA UEL: NA	TWA 0.050 mg/m^3 [b]	TWA 0.050 mg/m^3	100 mg/m^3
Manganese compounds and fume	Characteristics: lustrous, brittle, silvery solid. Exposure Routes: inhalation, ingestion. Target Organs: respiratory system, central nervous system, blood, kidneys. LEL: NA UEL: NA	TWA 1 mg/m^3 Short-term exposure limit (STEL) 3 mg/m^3	C 5 mg/m^3	500 mg/m^3

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Mercury compounds (except (organo) alkyls)	Characteristics: silver-white, heavy, odorless liquid. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, kidneys. LEL: NA UEL: NA	TWA 0.05 mg/m^3 ***C*** 0.1 mg/m^3	TWA 0.1 mg/m^3	10 mg/m^3
Nickel	Characteristics: lustrous, silvery, odorless solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: nasal cavities, lungs, skin. Cancer Site: lung and nasal cancer. LEL: NA UEL: NA	**Ca** TWA 0.015 mg/m^3	TWA 1 mg/m^3	**Ca** 10 mg/m^3
Selenium	Characteristics: amorphous or crystalline, red to gray solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys, blood, spleen. LEL: NA UEL: NA	TWA 0.2 mg/m3	TWA 0.2 mg/m3	1 mg/m^3
Silver	Characteristics: white, lustrous solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: nasal septum, skin, eyes. LEL: NA UEL: NA	TWA 0.01 mg/m3	TWA 0.01 mg/m3	10 mg/m^3
Tin	Characteristics: gray to almost silver-white, ductile, malleable, lustrous solid. Exposure Routes: inhalation, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. LEL: NA UEL: NA	TWA 2 mg/m^3	TWA 2 mg/m3	100 mg/m^3

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Vanadium (dust)	Characteristics: yellow-orange powder or dark-gray, odorless flakes dispersed in air. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, and respiratory system. LEL: NA UEL: NA	***C*** 0.05 mg/m^3	***C*** 0.5 mg/m^3	35 mg/m^3
Organic Compounds				
Coal tar pitch volatiles (anthracene, chrysene, benzo[(a]anthracene, benzo[a]pyrene, fluoranthene, fluorene, indenol[1,2,3-cd] pyrene, phenanthrene, pyrene, and other polycyclic aromatic hydrocarbons)	Characteristics: coal tar pitch is a black or dark brown, amorphous residue. Exposure Routes: inhalation, skin and/or eye contact. Target Organs: respiratory system, skin, bladder, kidneys. Cancer Site: lung, kidney, and skin cancer. LEL: NA UEL: NA	**Ca** TWA 0.1 mg/m^3	TWA 0.2 mg/m^3	**Ca** 80 mg/m^3
1,1-Dichloroethane (DCA)	Characteristics: colorless, oily liquid with a chloroform-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: skin, liver, kidneys, lungs, central nervous system. LEL: 5.4% UEL: 11.4%	TWA 100 parts per million (ppm)	TWA 100 ppm	3000 ppm

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
1,1-Dichloroethene (DCE) cis-1,2-DCE trans-1,2-DCE	Characteristics: colorless liquid or gas (above 89 °F) with a mild, sweet, chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. Cancer Site: in animals, liver and kidney tumors. LEL: 6.5% UEL: 15.5%	**Ca**	**Ca**	1000 ppm
1,1,1-Trichloroethane (TCA)	Characteristics: colorless liquid with a mild, chloroform-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, central nervous system, cardiovascular system, liver. LEL: 7.5% UEL: 12.5%	***C*** 350 ppm	TWA 350 ppm	700 ppm
1,1,2-TCA	Characteristics: colorless liquid with a sweet, chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, respiratory system, central nervous system, liver, kidneys. Cancer Site: in animals, liver cancer. LEL: 6.5% UEL: 15.5%	**Ca** TWA 10 ppm	TWA 10 ppm	**Ca** 100 ppm
1,1,2-Trichloro-1,2,2-trifluoroethane	Characteristics: colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: skin, heart, central nervous system, cardiovascular system. LEL: NA UEL: NA	TWA 1,000 ppm STEL 1,250 ppm	TWA 1,000 ppm	2000 ppm

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
1,1,1,2-Tetrachloroethane (PCA) 1,1,2,2-PCA	Characteristics: colorless to pale-yellow liquid with a pungent, chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: skin, liver, kidneys, central nervous system, gastrointestinal tract. Cancer Site: in animals, liver tumors. LEL: NA UEL: NA	**Ca** TWA 1 ppm	TWA 5 ppm	**Ca** 100 ppm
1,2-Dichloropropane	Characteristics: colorless liquid with a chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys, central nervous system. Cancer Site: in animals, liver and mammary gland tumors. LEL: 3.4% UEL: 14.5%	**Ca**	**Ca** TWA 75 ppm	**Ca** 400 ppm
1,2,4-Trichlorobenzene	Characteristics: colorless liquid or crystalline solid (below 63 °F) with an aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, reproductive system. LEL: 2.5% UEL: 6.6%	***C*** 5 ppm		
1,2,4-Trimethylbenzene	Characteristics: clear, colorless liquid with a distinctive, aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, blood. LEL: 0.9% UEL: 6.4%	TWA 25 ppm		

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
1,2-Benzenedicarboxylic acid	Characteristics: colorless, oily liquid with a slight, aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, respiratory system, gastrointestinal tract. LEL: 0.9% (358 °F) UEL: NA	TWA 5 mg/m^3	TWA 5 mg/m^3	2000 mg/m^3
1,2-Dibromo-3-chloropropane	Characteristics: dense yellow or amber liquid with a pungent odor at high concentrations. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys, spleen, reproductive system, digestive system. Cancer Site: in animals, cancer of the nasal cavity, tongue, pharynx, lungs, stomach, adrenal and mammary glands. LEL: NA UEL: NA	**Ca**	TWA 0.001 ppm	**Ca**
1,2-Dichlorobenzene	Characteristics: colorless to pale-yellow liquid with a pleasant, aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. LEL: 2.2% UEL: 9.2%	***C*** 50 ppm	***C*** 50 ppm	200 ppm

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
1,2-Dichloroethane	Characteristics: colorless liquid with a pleasant, chloroform-like odor. Exposure Routes: inhalation, ingestion, skin absorption, skin and/or eye contact. Target Organs: eyes, skin, kidneys, liver, central nervous system, cardiovascular system. Cancer Site: in animals, forestomach, mammary gland, and circulatory system cancer. LEL: 6.2% UEL: 16%	**Ca** TWA 1 ppm STEL 2 ppm	TWA 50 ppm ***C*** 100 ppm 200 ppm (5-min)	**Ca** 50 ppm
1,2-Dichloropropane	Characteristics: colorless liquid with a chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys, central nervous system. Cancer Site: in animals, liver and mammary gland tumors. LEL: 3.4% UEL: 14.5%	**Ca**	TWA 75 ppm	**Ca** 400 ppm
1,2,3-Trimethylbenzene	Characteristics: clear, colorless liquid with a distinctive, aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, blood. LEL: 0.8% UEL: 6.6%	TWA 25 ppm		
1,3,5-Trimethylbenzene	Characteristics: clear, colorless liquid with a distinctive, aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, blood. LEL: NA UEL: NA	TWA 25 ppm		

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
1,4-Dichlorobenzene	Characteristics: colorless or white crystalline solid with a mothball-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: liver, respiratory system, eyes, kidneys, skin. Cancer Site: in animals, liver and kidney cancer. LEL: 2.5% UEL: NA	**Ca**	TWA 75 ppm	**Ca** 150 ppm
1,4-Dioxane	Characteristics: colorless liquid or solid (below 53 °F) with a mild, ether-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. Cancer Site: in animals, lung, liver, and nasal cavity tumors. LEL: 2.0% UEL: 22.0%	**Ca** ***C*** 1 ppm (30-min)	TWA 100 ppm	**Ca** 500 ppm
2,3-Dimethylbutane	Characteristics: clear liquids with mild, gasoline-like odors. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: NA UEL: NA	***C*** 510 ppm (15-min) TWA 100 ppm		
2,4,5-T	Characteristics: colorless to tan, odorless, crystalline solid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: skin, liver, gastrointestinal tract. LEL: NA UEL: NA	TWA 10 mg/m^3	TWA 10 mg/m^3	250 mg/m^3

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
2,4-D	Characteristics: white to yellow, crystalline, odorless powder. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: skin, central nervous system, liver, kidneys. LEL: NA UEL: NA	TWA 10 mg/m^3	TWA 10 mg/m^3	100 mg/m^3
2-Butanone (methyl ethyl ketone [MEK])	Characteristics: colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.4% (200 °F) UEL: 11.4%(200 °F)	TWA 200 ppm STEL 300 ppm	TWA 200 ppm	3000 ppm
2-Butoxyethanol	Characteristics: colorless liquid with a mild, ether-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, hematopoietic system, blood, kidneys, liver, lymphoid system. LEL: 1.1% (200 °F) UEL: 12.7% (275 °F)	TWA 5 ppm	TWA 50 ppm	700 ppm
2-Hexanone	Characteristics: colorless liquid with an acetone-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, peripheral nervous system. LEL: NA UEL: 8%	TWA 1 ppm	TWA 100 ppm	1600 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
3,3'-Dichlorobenzidine	Characteristics: gray to purple, crystalline solid. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: bladder, liver, lung, skin, gastrointestinal tract. Cancer Site: in animals, liver and bladder cancer. LEL: NA UEL: NA	**Ca**	**Ca**	**Ca**
3-Methylpentane	Characteristics: clear liquids with mild, gasoline-like odors. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: NA UEL: NA	TWA 100 ppm ***C*** 510 ppm		
4-Methyl-2-pentanone (MIBK)	Characteristics: colorless liquid with a pleasant odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. LEL: 1.2% (200 °F) UEL: 8.0% (200 °F)	TWA 50 ppm STEL 75 ppm	TWA 100 ppm	3000 ppm
4-Nitroaniline	Characteristics: bright yellow, crystalline powder with a slight ammonia-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: respiratory system, blood, heart, liver. LEL: NA UEL: NA	TWA 3 mg/m^3	TWA 1 ppm	300 mg/m^3
Acetic Acid	Characteristics: colorless liquid or crystals with a sour, vinegar-like odor. Exposure Routes: inhalation, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, teeth. LEL: 4.0% UEL: 19.9%: (200 °F):	TWA 10 ppm STEL 15 ppm	TWA 10 ppm	50 ppm

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Acetone	Characteristics: colorless liquid with a fragrant, mint-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 2.5% UEL: 12.8%	TWA 250 ppm	TWA 1000 ppm	2500 ppm
Acrolein	Characteristics: colorless or yellow liquid with a piercing, disagreeable odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, heart. LEL: 2.8% UEL: 31%	TWA 0.1 ppm STEL 0.3 ppm	TWA 0.1 ppm	2 ppm
Aniline	Characteristics: colorless to brown, oily liquid with an aromatic amine-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: blood, cardiovascular system, eyes, liver, kidneys, respiratory system. Cancer Site: bladder cancer. LEL: 1.3% UEL: 11%	**Ca**	TWA 5 ppm	**Ca** 100 ppm
Benzene	Characteristics: colorless to light-yellow liquid with an aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, blood, central nervous system, bone marrow. Cancer Site: leukemia. LEL: 1.2% UEL: 7.8%	**Ca** TWA 0.1 ppm STEL 1 ppm	TWA 1 ppm STEL 5 ppm	**Ca** 500 ppm

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Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
bis(2-Chloroethyl) ether	Characteristics: colorless liquid with a chlorinated solvent-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, respiratory system, liver. Cancer Site: in animals, liver tumors. LEL: 2.7% UEL: NA	**Ca** TWA 5 ppm STEL 10 ppm	TWA 15 ppm	**Ca** 100 ppm
bis(2-Chloroethyl) sulfide [HD Mustard Agent]	Characteristics: colorless liquid with a garlic or mustard-like odor. Exposure Routes: inhalation, skin and/or eye contact. Target Organs: eyes, respiratory system. Cancer Site: mouth, throat, respiratory tract, skin, leukemia. LEL: NA UEL: NA	**Ca** TWA No data STEL 0.003 mg/m^3	TWA No data	**Ca** 2.0 mg/m^3
bis(2-Ethylhexyl)phthalate	Characteristics: colorless, oily liquid with a slight odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, respiratory system, central nervous system, liver, reproductive system, gastrointestinal tract. Cancer Site: in animals, liver tumors. LEL: 0.3%: (474 °F) UEL: NA	**Ca** TWA 5 mg/m^3 STEL 10 mg/m^3	TWA 5 mg/m^3	**Ca** 5000 mg/m^3
Bromoform	Characteristics: colorless to yellow liquid with a chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. LEL: NA UEL: NA	TWA 0.5 ppm	TWA 0.5 ppm	850 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Bromomethane (Methyl bromide)	Characteristics: colorless gas with a chloroform-like odor at high concentrations. Exposure Routes inhalation, skin absorption (liquid), skin and/or eye contact (liquid). Target Organs: eyes, skin, respiratory system, central nervous system. Cancer Site: in animals, lung, kidney, and forestomach tumors. LEL: 10% UEL: 16.0%	**Ca**	***C*** 20 ppm	**Ca** 250 ppm
Butane	Characteristics: colorless gas with a gasoline-like or natural gas odor. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: central nervous system. LEL: 1.6% UEL: 8.4%	TWA 800 ppm		
Butylated hydroxytoluene (2,6-Di-tert-butyl-p-cresol)	Characteristics: white to pale-yellow, crystalline solid with a slight, phenolic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin. LEL: NA UEL: NA	TWA 10 mg/m^3		
Camphor (synthetic)	Characteristics: colorless or white crystals with a penetrating, aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 0.6% UEL: 3.5%	TWA 2 mg/m^3	TWA 2 mg/m^3	200 mg/m^3

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Caprolactam	Characteristics: white, crystalline solid or flakes with an unpleasant odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, cardiovascular system, liver, kidneys. LEL: 1.4% UEL: 8.0%	Dust: TWA 1 mg/m^3 STEL 3 mg/m^3 Vapor: TWA 0.22 ppm STEL 0.66 ppm		
Carbon Disulfide	Characteristics: colorless to faint-yellow liquid with a sweet ether-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: central nervous system, peripheral nervous system, cardiovascular system, eyes, kidneys, liver, skin, reproductive system. LEL: 1.3% UEL: 50.0%	TWA 1 ppm STEL 10 ppm	TWA 20 ppm ***C*** 30 ppm 100 ppm (30-min)	500 ppm
Carbon tetrachloride	Characteristics: colorless liquid with a characteristic ether-like odor. Exposure Routes: inhalation, .skin absorption, ingestion, skin and/or eye contact. Target Organs: central nervous system, eyes, lungs, liver, kidneys, skin. Cancer Site: in animals, liver cancer. LEL: NA UEL: NA	**Ca** STEL 2 ppm (60-min)	TWA 10 ppm ***C*** 25 ppm 200 ppm (5-min)	**Ca** 200 ppm
Chlorobenzene	Characteristics: colorless liquid with an almond-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver. LEL: 1.3% UEL: 9.6%		TWA 75 ppm	1000 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Chlorodifluoromethane	Characteristics: colorless gas with a faint, sweetish odor. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: respiratory system, cardiovascular system, central nervous system, liver, kidneys, spleen. LEL: NA UEL: NA	TWA 1,000 ppm STEL 1,250 ppm		
Chloroethane (Ethyl chloride)	Characteristics: colorless gas or liquid (below 54 F) with a pungent, ether-like odor. Exposure Routes: inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact. Target Organs: liver, kidneys, respiratory system, cardiovascular system, central nervous system. LEL: NA UEL: NA	Handle with caution in the workplace	TWA 1,000 ppm	3800 ppm
Chloroform	Characteristics: colorless liquid with a pleasant odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: liver, kidneys, heart, eyes, skin, central nervous system. Cancer Site: in animals, liver, and kidney cancer. LEL: NA UEL: NA	**Ca** STEL 2 ppm (60-min)	***C*** 50 ppm	**Ca** 500 ppm
Chloromethane	Characteristics: colorless gas with a faint, sweet odor that is not noticeable at dangerous concentrations. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: central nervous system, liver, kidneys, reproductive system. Cancer Site: in animals, lung, kidney, and forestomach tumors. LEL: 8.1% UEL: 17.4%	**Ca**	TWA 100 ppm ***C*** 200 ppm 300 ppm (5-min)	2000 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Cyclohexane	Characteristics: colorless liquid with a sweet, chloroform-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.3% UEL: 8%	TWA 300 ppm	TWA 300 ppm	1300 ppm
Cyclohexanol	Characteristics: sticky solid or colorless to light-yellow liquid (above 77 °F) with a camphor-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. LEL: NA UEL: NA	TWA 50 ppm	TWA 50 ppm	400 ppm
Cyclopentane	Characteristics: colorless liquid with a mild, sweet odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.1% UEL: 8.7%	TWA 600 ppm		
Dalapon (2,2-Dichloropropionic acid)	Characteristics: colorless liquid with an acrid odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, gastrointestinal tract, central nervous system. LEL: NA UEL: NA	TWA 1 ppm		
Dichlorodifluoromethane	Characteristics: colorless gas with an ether-like odor at extremely high concentrations. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: cardiovascular system, peripheral nervous system. LEL: NA UEL: NA	TWA 1,000 ppm	TWA 1,000 ppm	15000 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Dichlorofluoromethane	Characteristics: colorless gas with a slight, ether-like odor. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: respiratory system, cardiovascular system. LEL: NA UEL: NA	TWA 10 ppm	TWA 1,000 ppm	5000 ppm
Diethyl phthalate	Characteristics: colorless to water-white, oily liquid with a very slight, aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, peripheral nervous system, reproductive system. LEL: 0.7% (368 °F) UEL: NA	TWA 5 mg/m^3		
Dimethyl phthalate (Methyl ethyl ketone peroxide)	Characteristics: colorless liquid with a characteristic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. LEL: NA UEL: NA	***C*** 0.2 ppm		
Di-n-butyl phthalate	Characteristics: colorless to faint-yellow, oily liquid with a slight, aromatic odor. Exposure Routes: inhalation, ingestion, skin, and/or eye contact. Target Organs: eyes, respiratory system, gastrointestinal tract. LEL: 0.5% (456 °F) UEL: NA	TWA 5 mg/m^3	TWA 5 mg/m^3	4000 mg/m^3
Ethyl acetate	Characteristics: colorless liquid with an ether-like, fruity odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. LEL: 2.0% UEL: 11.5%	TWA 400 ppm	TWA 400 ppm	2000 ppm

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Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Ethyl ether	Characteristics: colorless liquid with a pungent, sweetish odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.9% UEL: 36.0%		TWA 400 ppm	1900 ppm
Ethylbenzene	Characteristics: colorless liquid with an aromatic odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 0.8% UEL: 6.7%	TWA 100 ppm STEL 125 ppm	TWA 100 ppm	800 ppm
Hexachlorobutadiene	Characteristics: clear, colorless liquid with a mild, turpentine-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, kidneys. Cancer Site: in animals, kidney tumors. LEL: NA UEL: NA	**Ca** TWA 0.02 ppm		**Ca**
Hexachlorocyclopentadiene	Characteristics: pale-yellow to amber-colored liquid with a pungent, unpleasant odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. LEL: NA UEL: NA	TWA 0.01 ppm		

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Hexachloroethane	Characteristics: colorless crystals with a camphor-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, kidneys Cancer Site: in animals, liver cancer. LEL: NA UEL: NA	**Ca** TWA 1 ppm	TWA 1 ppm	**Ca** 300 ppm
Indene	Characteristics: colorless liquid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys, spleen. LEL: NA UEL: NA	TWA 10 ppm		
Iodomethane (Methyl iodide)	Characteristics: colorless liquid with a pungent, ether-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. Cancer Site: in animals, lung, kidney, and forestomach tumors. LEL: NA UEL: NA	**Ca** TWA 2 ppm	TWA 5 ppm	**Ca** 100 ppm
Isobutane	Characteristics: colorless gas with a gasoline-like or natural gas odor. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: central nervous system. LEL: 1.6% UEL: 8.4%	TWA 800 ppm		
Isophorone	Characteristics: colorless to white liquid with a peppermint-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. LEL: 0.8% UEL: 3.8%	TWA 4 ppm	TWA 25 ppm	200 ppm

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Isopropyl ether	Characteristics: colorless liquid with a sharp, sweet, ether-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.4% UEL: 7.9%	TWA 500 ppm	TWA 500 ppm	1400 ppm
Methylcyclohexane	Characteristics: colorless liquid with a faint, benzene-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: 1.2% UEL: 6.7%	TWA 400 ppm	TWA 500 ppm	1200 ppm
Methylene Chloride	Characteristics: colorless liquid with a chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, cardiovascular system, central nervous system. Cancer Site: in animals, lung, liver, salivary gland, and mammary gland tumors. LEL: 13.0% UEL: 23.0%	**Ca**	TWA 25 ppm STEL 125 ppm	**Ca** 2300 ppm
m-Xylene	Characteristics: colorless liquid with an aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys. LEL: 1.1% UEL: 7.0%	TWA 100 ppm STEL 150 ppm	TWA 100 ppm	900 ppm

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Naphthalene	Characteristics: colorless to brown solid with an odor of mothballs. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, blood, liver, kidneys, central nervous system. LEL: 0.9% UEL: 5.9%	TWA 10 ppm STEL 15 ppm	TWA 10 ppm	250 ppm
Nitrobenzene	Characteristics: yellow, oily liquid with a pungent odor like paste shoe polish. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, blood, liver, kidneys, cardiovascular system, reproductive system. LEL: 1.8% (200 °F) UEL: NA	TWA 1 ppm	TWA 1 ppm	200 ppm
N-Nitrosodimethylamine	Characteristics: yellow, oily liquid with a faint, characteristic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: liver, kidneys, lungs. Cancer Site: in animals, lung, kidney, liver, and nasal cavity tumors. LEL: NA UEL: NA	**Ca**	**Ca**	**Ca**
Pentachloroethane	Characteristics: colorless liquid with a sweetish, chloroform-like odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. LEL: NA UEL: NA	Handle with care in the workplace.		

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Pentachlorophenol	Characteristics: colorless to white, crystalline solid with a benzene-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, cardiovascular system, liver, kidneys, central nervous system. LEL: NA UEL: NA	TWA 0.5 mg/m^3	TWA 0.5 mg/m^3	2.5 mg/m^3
2-methyl-PentaneHexane isomers (except n-hexane)	Characteristics: clear liquids with mild, gasoline-like odors. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system. LEL: NA UEL: NA	TWA 100 ppm ***C*** 510 ppm (15-min)		
Phenol	Characteristics: colorless to light-pink, crystalline solid with a sweet, acrid odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. LEL: NA UEL: NA	TWA 5 ppm ***C*** 15.6 ppm (15-min)	TWA 5 pp	250 ppm
Phthalic anhydride	Characteristics: white solid (flake) or a clear, colorless, mobile liquid (molten) with a characteristic, acrid odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys. LEL: 1.7% UEL: 10.5%	TWA 1 ppm	TWA 2 ppm	60 mg/m^3

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Pyridine	Characteristics: colorless to yellow liquid with a nauseating, fish-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, central nervous system, liver, kidneys, gastrointestinal tract. LEL: 1.8% UEL: 12.4%	TWA 5 ppm	TWA 5 ppm	1,000 ppm
Royal Demolition Explosive	Inhalation: toxic effects central nervous system effects, including nausea, vomiting, convulsions, and unconsciousness. Ingestion: Toxic effects include gastrointestinal irritation, central nervous system effects, including nausea, vomiting, convulsions, and unconsciousness.	1,500 mg/m^3	1.5 mg/m^3	None Established
Styrene	Characteristics: colorless to yellow, oily liquid with a sweet, floral odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, reproductive system. LEL: 0.9% UEL: 6.8%	TWA 50 ppm STEL 100 ppm	TWA 100 ppm ***C*** 200 ppm 600 ppm (5-min)	700 ppm
Tetrachloroethene (PCE)	Characteristics: colorless liquid with a mild, chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, liver, kidneys, central nervous system. Cancer Site: in animals, liver tumors. LEL: NA UEL: NA	**Ca**	TWA 100 ppm ***C*** 200 ppm (5-min) with max peak of 300 ppm	**Ca** 150 ppm

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL[a]**	**OSHA PEL[a]**	**IDLH [a]**
Thallium	Characteristics: appearance and odor vary depending upon the specific soluble thallium compound. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, respiratory system, central nervous system, liver, kidneys, gastrointestinal tract, body hair. LEL: NA UEL: NA	TWA 0.1 mg/m^3	TWA 0.1 mg/m^3	15 mg/m^3
Toluene	Characteristics: clear liquid with a characteristic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, liver, kidneys. LEL: 1.1% UEL: 7.1%	TWA 100 ppm STEL 150 ppm	TWA 200 ppm ***C*** 300 ppm 500 ppm (10-min)	500 ppm
Tributyl phosphate	Characteristics: colorless to pale-yellow, odorless liquid. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. LEL: NA UEL: NA	TWA 0.2 ppm	TWA 5 mg/m^3	30 ppm
trichloroethene (TCE)	Characteristics: colorless liquid (unless dyed blue) with a chloroform-like odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, heart, liver, kidneys, central nervous system. Cancer Site: in animals, liver and kidney cancer. LEL: 8.0% UEL: 10.5%	**Ca**	TWA 100 ppm ***C*** 200 ppm (5-min) with max peak of 300 ppm	**Ca** 1,000 ppm

Tab B

Chemical, Physical, and Toxicological Properties of Toxic and Hazardous Materials

Contaminant (Synonym)	**Physical/Chemical Characteristics, Exposure Routes, and Target Organs**	**NIOSH REL**[a]	**OSHA PEL**[a]	**IDLH** [a]
Trichlorofluoromethane (Fluorotrichloromethane)	Characteristics: colorless to water-white, nearly odorless liquid or gas (above 75 °F). Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: skin, respiratory system, cardiovascular system. LEL: NA UEL: NA	***C*** 1,000 ppm	TWA 1,000 ppm	2,000 ppm
Vinyl acetate	Characteristics: colorless liquid with a pleasant, fruity odor. Exposure Routes: inhalation, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system. LEL: 2.6% UEL: 13.4%	***C*** 4 ppm (15-min)		
Vinyl Chloride	Characteristics: colorless gas or liquid (below 7 °F) with a pleasant odor at high concentrations. Exposure Routes: inhalation, skin and/or eye contact (liquid). Target Organs: liver, central nervous system, blood, respiratory system, lymphatic system. Cancer Site: liver cancer. LEL: 3.6% UEL: 33.0%	**Ca**	TWA 1 ppm ***C*** 5 ppm	**Ca**
Xylenes	Characteristics: colorless liquid with an aromatic odor. Exposure Routes: inhalation, skin absorption, ingestion, skin and/or eye contact. Target Organs: eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys. LEL: 1.1% UEL: 7.0%	TWA 100 ppm STEL 150 ppm	TWA 100 ppm	900 ppm

Notes:

[a] – values obtained from NIOSH Pocket Guide to Chemical Hazards.
[b] – the time-weighted average concentration for up to an 8-hour workday.
[c] – Toxicological Profile for Mustard Sulfur (Update), U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.2003.
5-min – the maximum peak concentration in any 3 hours.
10-min – the maximum peak concentration over a 10-minute interval.
15-min – the maximum peak concentration over a 15-minute interval.
30-min – the maximum peak concentration over a 30-minute interval.
% – percent
Blank – no NIOSH REL, OSHA PEL, or IDLH value available.
C – the ceiling value which should not be exceeded at any time.
Ca – known carcinogen.
IDLH – immediately dangerous to life and health
LEL – lower explosive limit.
max – maximum
mg/m^3 – milligrams per cubic meter.
NA – not available
NIOSH – National Institute for Occupational Safety and Health.
OSHA – Occupational Safety and Health Administration.
PEL – permissible exposure limit.
ppm – parts per million.
REL – recommended exposure limit.
STEL – the short-term exposure limit STEL is a 15-minute TWA exposure that should not be exceeded at any time during a workday.
TWA – the time-weighted average concentration for up to a 10-hour workday during a 40-hour workweek.
UEL – upper explosive limit.

Tab C

Safety Inspection and Incident/Accident Reporting Forms

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Safety Inspection and Incident /Accident Reporting Forms

- C.1 - Health and Safety Inspection Form
- C.2 - OSHA 300, 300A, 301 Forms
- C.3 - TechLaw Incident Reporting Forms
- C.4 - USACE 3394 Form

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C.1

Health and Safety Inspection Form

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HEALTH AND SAFETY INSPECTION FORM

Date: ____

Project Name/Number: ____

Site: ____

Inspection Details and Type: ____
____
____

Complete daily for each site. Answer each question by checking the appropriate column (yes, no, or N/A). If a No *is checked, provide an explanation on the Noncompliance and Corrective Actions form.*

Administration	**Yes**	**No**	**N/A**
• Is there an activity hazard analysis (AHA) for the task?	☐	☐	☐
• Are the tasks being completed reflected in the AHA?	☐	☐	☐
• Was the tailgate meeting performed and recorded?	☐	☐	☐

Electrical	**Yes**	**No**	**N/A**
• Are cords in good condition?	☐	☐	☐
• Are cords protected from traffic?	☐	☐	☐
• Are energized parts protected?	☐	☐	☐
• Are GFCI’s utilized?	☐	☐	☐

Environmental	**Yes**	**No**	**N/A**
• Are containers labeled?	☐	☐	☐
• Is spill containment adequate?	☐	☐	☐
• Are spill kits available?	☐	☐	☐
• Were vehicle/machinery leaks observed?	☐	☐	☐

Fire Protection	**Yes**	**No**	**N/A**
• Has the fire extinguisher been charged and inspected?	☐	☐	☐
• Are the proper fuel containers utilized?	☐	☐	☐

Hand and Power Tools	**Yes**	**No**	**N/A**
• Are cords in good condition?	☐	☐	☐
• Are ground prong in place?	☐	☐	☐
• Are guards in place?	☐	☐	☐
• Are hoses in good condition?	☐	☐	☐
• Are proper tools being used for the job?	☐	☐	☐
• Are tools in good condition?	☐	☐	☐

Housekeeping	**Yes**	**No**	**N/A**
• Are roadways around work areas clear?	☐	☐	☐
• Are slip, trip, and fall hazards present?	☐	☐	☐
• Are walkways clear?	☐	☐	☐

Medical/Emergency	**Yes**	**No**	**N/A**
• Are first aid kits readily available with necessary supplies?	☐	☐	☐
• Are emergency numbers clearly posted?	☐	☐	☐
• Are eyewash kits available and full?	☐	☐	☐
• Is the map to the medical facility clearly posted?	☐	☐	☐

Motorized Equipment	**Yes**	**No**	**N/A**
• Are back up alarms on vehicles functioning properly?	☐	☐	☐
• Is the horn on vehicles functioning properly?	☐	☐	☐
• Do operator appears competent?	☐	☐	☐
• Are training documents available?	☐	☐	☐

Personal Protection Equipment	**Yes**	**No**	**N/A**
• Are glasses/face shields being properly used?	☐	☐	☐
• Are gloves be properly used?	☐	☐	☐
• Are hard hats being properly used?	☐	☐	☐
• Is hearing protection being properly used?	☐	☐	☐

Inspector Signature: ______________________________ Date:___________________________

C.2

OSHA 300, 300A, 301 Forms

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OSHA
Forms for Recording Work-Related Injuries and Illnesses

Dear Employer:

This booklet includes the forms needed for maintaining occupational injury and illness records for 2004. These new forms have changed in several important ways from the 2003 recordkeeping forms.

In the December 17, 2002 Federal Register (67 FR 77165-77170), OSHA announced its decision to add an occupational hearing loss column to OSHA's Form 300, Log of Work-Related Injuries and Illnesses. This forms package contains modified Forms 300 and 300A which incorporate the additional column M(5) Hearing Loss. Employers required to complete the injury and illness forms must begin to use these forms on January 1, 2004.

In response to public suggestions, OSHA also has made several changes to the forms package to make the recordkeeping materials clearer and easier to use:

- On Form 300, we've switched the positions of the day count columns. The days "away from work" column now comes before the days "on job transfer or restriction."
- We've clarified the formulas for calculating incidence rates.
- We've added new recording criteria for occupational hearing loss to the "Overview" section.
- On Form 300, we've made the column heading "Classify the Case" more prominent to make it clear that employers should mark only one selection among the four columns offered.

The Occupational Safety and Health Administration shares with you the goal of preventing injuries and illnesses in our nation's workplaces. Accurate injury and illness records will help us achieve that goal.

Occupational Safety and Health Administration
U.S. Department of Labor

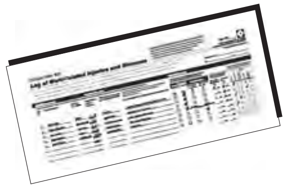
What's Inside...

In this package, you'll find everything you need to complete OSHA's *Log* and the *Summary of Work-Related Injuries and Illnesses* for the next several years. On the following pages, you'll find:

▼ ***An Overview: Recording Work-Related Injuries and Illnesses* —** General instructions for filling out the forms in this package and definitions of terms you should use when you classify your cases as injuries or illnesses.

▼ ***How to Fill Out the Log* —** An example to guide you in filling out the *Log* properly.

▼ ***Log of Work-Related Injuries and Illnesses* —** Several pages of the *Log* (but you may make as many copies of the *Log* as you need.) Notice that the *Log* is separate from the *Summary.*



▼ ***Summary of Work-Related Injuries and Illnesses* —** Removable *Summary* pages for easy posting at the end of the year. Note that you post the *Summary* only, not the *Log*.

▼ ***Worksheet to Help You Fill Out the Summary* —** A worksheet for figuring the average number of employees who worked for your establishment and the total number of hours worked.

▼ ***OSHA's 301: Injury and Illness Incident Report* —** A copy of the OSHA 301 to provide details about the incident. You may make as many copies as you need or use an equivalent form.

Take a few minutes to review this package. If you have any questions, ***visit us online at www.osha. gov* or *call your local OSHA office*.** We'll be happy to help you.

U.S. Department of Labor
Occupational Safety and Health Administration

An Overview:
Recording Work-Related Injuries and Illnesses

The Occupational Safety and Health (OSH) Act of 1970 requires certain employers to prepare and maintain records of work-related injuries and illnesses. Use these definitions when you classify cases on the Log. OSHA's recordkeeping regulation (see 29 CFR Part 1904) provides more information about the definitions below.

The *Log of Work-Related Injuries and Illnesses* (Form 300) is used to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, use the *Log* to record specific details about what happened and how it happened. The *Summary* — a separate form (Form 300A) — shows the totals for the year in each category. At the end of the year, post the *Summary* in a visible location so that your employees are aware of the injuries and illnesses occurring in their workplace.

Employers must keep a *Log* for each establishment or site. If you have more than one establishment, you must keep a separate *Log* and *Summary* for each physical location that is expected to be in operation for one year or longer.

Note that your employees have the right to review your injury and illness records. For more information, see 29 Code of Federal Regulations Part 1904.35, *Employee Involvement.*

Cases listed on the *Log of Work-Related Injuries and Illnesses* are not necessarily eligible for workers' compensation or other insurance benefits. Listing a case on the *Log* does not mean that the employer or worker was at fault or that an OSHA standard was violated.

When is an injury or illness considered work-related?

An injury or illness is considered work-related if an event or exposure in the work environment caused or contributed to the condition or significantly aggravated a preexisting condition. Work-relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the workplace, unless an exception specifically applies. See 29 CFR Part 1904.5(b)(2) for the exceptions. The work environment includes the establishment and other locations where one or more employees are working or are present as a condition of their employment. See 29 CFR Part 1904.5(b)(1).

Which work-related injuries and illnesses should you record?

Record those work-related injuries and illnesses that result in:

- death,
- loss of consciousness,
- days away from work,
- restricted work activity or job transfer, or
- medical treatment beyond first aid.

You must also record work-related injuries and illnesses that are significant (as defined below) or meet any of the additional criteria listed below.

You must record any significant work-related injury or illness that is diagnosed by a physician or other licensed health care professional. You must record any work-related case involving cancer, chronic irreversible disease, a fractured or cracked bone, or a punctured eardrum. See 29 CFR 1904.7.

What are the additional criteria?

You must record the following conditions when they are work-related:

- any needlestick injury or cut from a sharp object that is contaminated with another person's blood or other potentially infectious material;
- any case requiring an employee to be medically removed under the requirements of an OSHA health standard;
- tuberculosis infection as evidenced by a positive skin test or diagnosis by a physician or other licensed health care professional after exposure to a known case of active tuberculosis.
- an employee's hearing test (audiogram) reveals 1) that the employee has experienced a Standard Threshold Shift (STS) in hearing in one or both ears (averaged at 2000, 3000, and 4000 Hz) and 2) the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (also averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS.

What is medical treatment?

Medical treatment includes managing and caring for a patient for the purpose of combating disease or disorder. The following are not considered medical treatments and are NOT recordable:

- visits to a doctor or health care professional solely for observation or counseling;

What do you need to do?

1. Within 7 calendar days after you receive information about a case, decide if the case is recordable under the OSHA recordkeeping requirements.
2. Determine whether the incident is a new case or a recurrence of an existing one.
3. Establish whether the case was work-related.
4. If the case is recordable, decide which form you will fill out as the injury and illness incident report.

   You may use *OSHA's 301: Injury and Illness Incident Report* or an equivalent form. Some state workers compensation, insurance, or other reports may be acceptable substitutes, as long as they provide the same information as the OSHA 301.

How to work with the Log

1. Identify the employee involved unless it is a privacy concern case as described below.
2. Identify when and where the case occurred.
3. Describe the case, as specifically as you can.
4. Classify the seriousness of the case by recording the **most serious outcome** associated with the case, with column G (Death) being the most serious and column J (Other recordable cases) being the least serious.
5. Identify whether the case is an injury or illness. If the case is an injury, check the injury category. If the case is an illness, check the appropriate illness category.

U.S. Department of Labor
Occupational Safety and Health Administration

- diagnostic procedures, including administering prescription medications that are used solely for diagnostic purposes; and
- any procedure that can be labeled first aid. (*See below for more information about first aid.*)

What is first aid?

If the incident required only the following types of treatment, consider it first aid. Do NOT record the case if it involves only:

- using non-prescription medications at non-prescription strength;
- administering tetanus immunizations;
- cleaning, flushing, or soaking wounds on the skin surface;
- using wound coverings, such as bandages, BandAids™, gauze pads, etc., or using SteriStrips™ or butterfly bandages.
- using hot or cold therapy;
- using any totally non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc.;
- using temporary immobilization devices while transporting an accident victim (splints, slings, neck collars, or back boards).
- drilling a fingernail or toenail to relieve pressure, or draining fluids from blisters;
- using eye patches;
- using simple irrigation or a cotton swab to remove foreign bodies not embedded in or adhered to the eye;
- using irrigation, tweezers, cotton swab or other simple means to remove splinters or foreign material from areas other than the eye;
- using finger guards;
- using massages;
- drinking fluids to relieve heat stress

How do you decide if the case involved restricted work?

Restricted work activity occurs when, as the result of a work-related injury or illness, an employer or health care professional keeps, or recommends keeping, an employee from doing the routine functions of his or her job or from working the full workday that the employee would have been scheduled to work before the injury or illness occurred.

How do you count the number of days of restricted work activity or the number of days away from work?

Count the number of calendar days the employee was on restricted work activity or was away from work as a result of the recordable injury or illness. Do not count the day on which the injury or illness occurred in this number. Begin counting days from the day after the incident occurs. If a single injury or illness involved both days away from work and days of restricted work activity, enter the total number of days for each. You may stop counting days of restricted work activity or days away from work once the total of either or the combination of both reaches 180 days.

Under what circumstances should you NOT enter the employee's name on the OSHA Form 300?

You must consider the following types of injuries or illnesses to be privacy concern cases:

- an injury or illness to an intimate body part or to the reproductive system,
- an injury or illness resulting from a sexual assault,
- a mental illness,
- a case of HIV infection, hepatitis, or tuberculosis,
- a needlestick injury or cut from a sharp object that is contaminated with blood or other potentially infectious material (see 29 CFR Part 1904.8 for definition), and
- other illnesses, if the employee independently and voluntarily requests that his or her name not be entered on the log.

You must not enter the employee's name on the OSHA 300 *Log* for these cases. Instead, enter "privacy case" in the space normally used for the employee's name. You must keep a separate, confidential list of the case numbers and employee names for the establishment's privacy concern cases so that you can update the cases and provide information to the government if asked to do so.

If you have a reasonable basis to believe that information describing the privacy concern case may be personally identifiable even though the employee's name has been omitted, you may use discretion in describing the injury or illness on both the OSHA 300 and 301 forms. You must enter enough information to identify the cause of the incident and the general severity of the injury or illness, but you do not need to include details of an intimate or private nature.

What if the outcome changes after you record the case?

If the outcome or extent of an injury or illness changes after you have recorded the case, simply draw a line through the original entry or, if you wish, delete or white-out the original entry. Then write the new entry where it belongs. Remember, you need to record the most serious outcome for each case.

Classifying injuries

An injury is any wound or damage to the body resulting from an event in the work environment.

Examples: Cut, puncture, laceration, abrasion, fracture, bruise, contusion, chipped tooth, amputation, insect bite, electrocution, or a thermal, chemical, electrical, or radiation burn. Sprain and strain injuries to muscles, joints, and connective tissues are classified as injuries when they result from a slip, trip, fall or other similar accidents.

Classifying illnesses

Skin diseases or disorders

Skin diseases or disorders are illnesses involving the worker's skin that are caused by work exposure to chemicals, plants, or other substances.

Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; friction blisters, chrome ulcers; inflammation of the skin.

Respiratory conditions

Respiratory conditions are illnesses associated with breathing hazardous biological agents, chemicals, dust, gases, vapors, or fumes at work.

Examples: Silicosis, asbestosis, pneumonitis, pharyngitis, rhinitis or acute congestion; farmer's lung, beryllium disease, tuberculosis, occupational asthma, reactive airways dysfunction syndrome (RADS), chronic obstructive pulmonary disease (COPD), hypersensitivity pneumonitis, toxic inhalation injury, such as metal fume fever, chronic obstructive bronchitis, and other pneumoconioses.

Poisoning

Poisoning includes disorders evidenced by abnormal concentrations of toxic substances in blood, other tissues, other bodily fluids, or the breath that are caused by the ingestion or absorption of toxic substances into the body.

Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzene, benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays, such as parathion or lead arsenate; poisoning by other chemicals, such as formaldehyde.

Hearing Loss

Noise-induced hearing loss is defined for recordkeeping purposes as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more in either ear at 2000, 3000 and 4000 hertz, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (also averaged at 2000, 3000, and 4000 hertz) in the same ear(s).

All other illnesses

All other occupational illnesses.

Examples: Heatstroke, sunstroke, heat exhaustion, heat stress and other effects of environmental heat; freezing, frostbite, and other effects of exposure to low temperatures; decompression sickness; effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flash, ultra-violet rays, lasers); anthrax; bloodborne pathogenic diseases, such as AIDS, HIV, hepatitis B or hepatitis C; brucellosis; malignant or benign tumors; histoplasmosis; coccidioidomycosis.

When must you post the Summary?

You must post the *Summary* only — not the *Log* — by February 1 of the year following the year covered by the form and keep it posted until April 30 of that year.

How long must you keep the Log and Summary on file?

You must keep the *Log* and *Summary* for 5 years following the year to which they pertain.

Do you have to send these forms to OSHA at the end of the year?

No. You do not have to send the completed forms to OSHA unless specifically asked to do so.

How can we help you?

If you have a question about how to fill out the *Log*,

☐ ***visit us online at www.osha.gov*** or

☐ ***call your local OSHA office.***

Optional

Calculating Injury and Illness Incidence Rates

What is an incidence rate?

An incidence rate is the number of recordable injuries and illnesses occurring among a given number of full-time workers (usually 100 full-time workers) over a given period of time (usually one year). To evaluate your firm's injury and illness experience over time or to compare your firm's experience with that of your industry as a whole, you need to compute your incidence rate. Because a specific number of workers and a specific period of time are involved, these rates can help you identify problems in your workplace and/or progress you may have made in preventing work-related injuries and illnesses.

How do you calculate an incidence rate?

You can compute an occupational injury and illness incidence rate for all recordable cases or for cases that involved days away from work for your firm quickly and easily. The formula requires that you follow instructions in paragraph (a) below for the total recordable cases or those in paragraph (b) for cases that involved days away from work, *and* for both rates the instructions in paragraph (c).

(a) *To find out the total number of recordable injuries and illnesses that occurred during the year,* count the number of line entries on your OSHA Form 300, or refer to the OSHA Form 300A and sum the entries for columns (G), (H), (I), and (J).

(b) *To find out the number of injuries and illnesses that involved days away from work,* count the number of line entries on your OSHA Form 300 that received a check mark in column (H), or refer to the entry for column (H) on the OSHA Form 300A.

(c) *The number of hours all employees actually worked during the year*. Refer to OSHA Form 300A and optional worksheet to calculate this number.

You can compute the incidence rate for all recordable cases of injuries and illnesses using the following formula:

Total number of injuries and illnesses x *200,000 ÷ Number of hours worked by all employees = Total recordable case rate*

(The 200,000 figure in the formula represents the number of hours 100 employees working 40 hours per week, 50 weeks per year would work, and provides the standard base for calculating incidence rates.)

You can compute the incidence rate for recordable cases involving days away from work, days of restricted work activity or job transfer (DART) using the following formula:

(Number of entries in column H + Number of entries in column I) x *200,000 ÷ Number of hours worked by all employees = DART incidence rate*

You can use the same formula to calculate incidence rates for other variables such as cases involving restricted work activity (column (I) on Form 300A), cases involving skin disorders (column (M-2) on Form 300A), etc. Just substitute the appropriate total for these cases, from Form 300A, into the formula in place of the total number of injuries and illnesses.

What can I compare my incidence rate to?

The Bureau of Labor Statistics (BLS) conducts a survey of occupational injuries and illnesses each year and publishes incidence rate data by various classifications (e.g., by industry, by employer size, etc.). You can obtain these published data at www.bls.gov/iif or by calling a BLS Regional Office.

Worksheet

Total number of injuries and illnesses				Number of hours worked by all employees		Total recordable case rate
☐	X	200,000	÷	☐	=	☐

Number of entries in Column H + Column I				Number of hours worked by all employees		DART incidence rate
☐	X	200,000	÷	☐	=	☐

How to Fill Out the Log

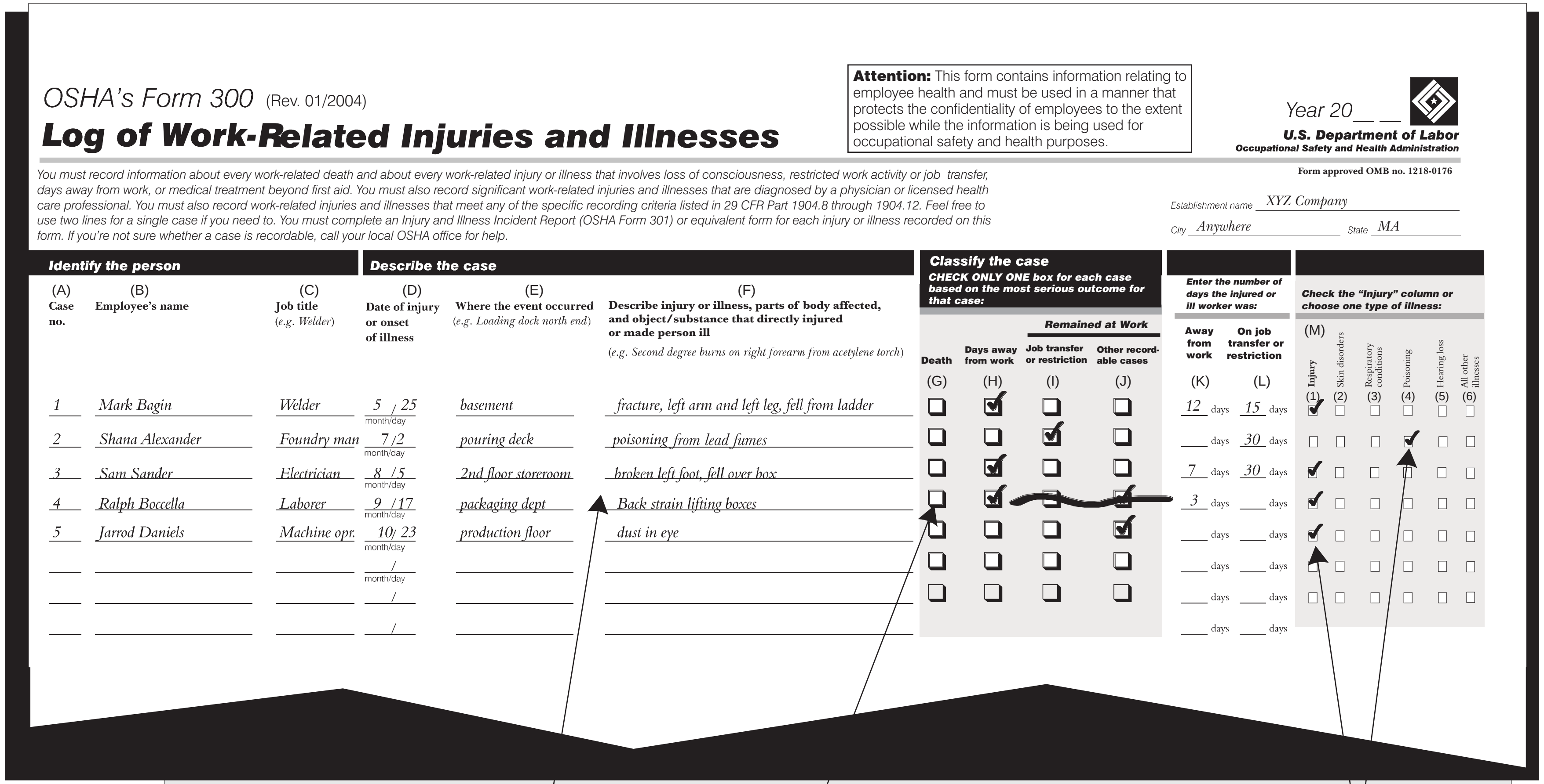
The *Log of Work-Related Injuries and Illnesses* is used to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, use the *Log* to record specific details about what happened and how it happened.

If your company has more than one establishment or site, you must keep separate records for each physical location that is expected to remain in operation for one year or longer.

We have given you several copies of the *Log* in this package. If you need more than we provided, you may photocopy and use as many as you need.

The *Summary* — a separate form — shows the work-related injury and illness totals for the year in each category. At the end of the year, count the number of incidents in each category and transfer the totals from the *Log* to the *Summary*. Then post the *Summary* in a visible location so that your employees are aware of injuries and illnesses occurring in their workplace.

You don't post the Log. You post only the Summary at the end of the year.



OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name XYZ Company
City Anywhere State MA

Identify the person			Describe the case			Classify the case CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness:					
								Remained at Work				(M)					
(A) Case no.	(B) Employee's name	(C) Job title (e.g. Welder)	(D) Date of injury or onset of illness	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	(G) Death	(H) Days away from work	(I) Job transfer or restriction	(J) Other recordable cases	(K) Away from work	(L) On job transfer or restriction	(1) Injury	(2) Skin disorders	(3) Respiratory conditions	(4) Poisoning	(5) Hearing loss	(6) All other illnesses
1	Mark Bagin	Welder	5 / 25 month/day	basement	fracture, left arm and left leg, fell from ladder	☐	☑	☐	☐	12 days	15 days	☑	☐	☐	☐	☐	☐
2	Shana Alexander	Foundry man	7 /2 month/day	pouring deck	poisoning from lead fumes	☐	☐	☑	☐	___ days	30 days	☐	☐	☐	☑	☐	☐
3	Sam Sander	Electrician	8 /5 month/day	2nd floor storeroom	broken left foot, fell over box	☐	☑	☐	☐	7 days	30 days	☑	☐	☐	☐	☐	☐
4	Ralph Boccella	Laborer	9 /17 month/day	packaging dept	Back strain lifting boxes	☐	☑	~~☐~~	~~☑~~	3 days	___ days	☑	☐	☐	☐	☐	☐
5	Jarrod Daniels	Machine opr.	10/ 23 month/day	production floor	dust in eye	☐	☐	☐	☑	___ days	___ days	☑	☐	☐	☐	☐	☐
			/ month/day			☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
			/			☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
			/							___ days	___ days						

Be as specific as possible. You can use two lines if you need more room.

Revise the log if the injury or illness progresses and the outcome is more serious than you originally recorded for the case. Cross out, erase, or white-out the original entry.

Choose ONLY ONE of these categories. Classify the case by recording the most serious outcome of the case, with column G (Death) being the most serious and column J (Other recordable cases) being the least serious.

Note whether the case involves an injury or an illness.

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________________

City ____________________ *State* ______________

Identify the person			**Describe the case**			**Classify the case** ***CHECK ONLY ONE box for each case based on the most serious outcome for that case:***				***Enter the number of days the injured or ill worker was:***		***Check the "Injury" column or choose one type of illness:***					
(A) **Case no.**	(B) **Employee's name**	(C) **Job title** (*e.g., Welder*)	(D) **Date of injury or onset of illness**	(E) **Where the event occurred** (*e.g., Loading dock north end*)	(F) **Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill** (*e.g., Second degree burns on right forearm from acetylene torch*)	**Death** (G)	**Days away from work** (H)	***Remained at Work*** **Job transfer or restriction** (I)	**Other record-able cases** (J)	**Away from work** (K)	**On job transfer or restriction** (L)	(M) **Injury** (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
____	____________	________	__/__ month/day	________	________________	☐	☐	☐	☐	____ days	____ days	☐	☐	☐	☐	☐	☐
					Page totals ➤	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

A2-206

Page ___ ***of*** ___

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OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
____________	____________	____________	____________
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
____________	____________
(K)	(L)

Injury and Illness Types

Total number of . . .
(M)

(1) Injuries ______
(2) Skin disorders ______
(3) Respiratory conditions ______
(4) Poisonings ______
(5) Hearing loss ______
(6) All other illnesses ______

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 58 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name ________________________________

Street ________________________________

City ____________________ State _____ ZIP ________

Industry description (*e.g., Manufacture of motor truck trailers*)

____

Standard Industrial Classification (SIC), if known (*e.g., 3715*)

___ ___ ___ ___

OR

North American Industrial Classification (NAICS), if known (e.g., 336212)

___ ___ ___ ___ ___ ___

Employment information *(If you don't have these figures, see the Worksheet on the back of this page to estimate.)*

Annual average number of employees __________

Total hours worked by all employees last year __________

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

____
Company executive Title

( ) - / /
Phone Date

Optional

Worksheet to Help You Fill Out the Summary

At the end of the year, OSHA requires you to enter the average number of employees and the total hours worked by your employees on the summary. If you don't have these figures, you can use the information on this page to estimate the numbers you will need to enter on the Summary page at the end of the year.

How to figure the average number of employees who worked for your establishment during the year:

❶ ***Add*** the total number of employees your establishment paid in all pay periods during the year. Include all employees: full-time, part-time, temporary, seasonal, salaried, and hourly.

The number of employees paid in all pay periods = ❶ ________

❷ ***Count*** the number of pay periods your establishment had during the year. Be sure to include any pay periods when you had no employees.

The number of pay periods during the year = ❷ ________

❸ ***Divide*** the number of employees by the number of pay periods.

$\frac{❶}{❷}$ ________ = ❸ ________

❹ ***Round the answer*** to the next highest whole number. Write the rounded number in the blank marked *Annual average number of employees.*

The number rounded = ❹ ________

For example, Acme Construction figured its average employment this way:

For pay period...	**Acme paid this number of employees...**
1	10
2	0
3	15
4	30
5	40
▼	▼
24	20
25	15
26	+10
	830

Number of employees paid = 830 ❶

Number of pay periods = 26 ❷

$\frac{830}{26} = 31.92$ ❸

31.92 rounds to 32 ❹

32 is the annual average number of employees

How to figure the total hours worked by all employees:

Include hours worked by salaried, hourly, part-time and seasonal workers, as well as hours worked by other workers subject to day to day supervision by your establishment (e.g., temporary help services workers).

Do not include vacation, sick leave, holidays, or any other non-work time, even if employees were paid for it. If your establishment keeps records of only the hours paid or if you have employees who are not paid by the hour, please estimate the hours that the employees actually worked.

If this number isn't available, you can use this optional worksheet to estimate it.

Optional Worksheet

________ ***Find*** the number of full-time employees in your establishment for the year.

X ________ ***Multiply*** by the number of work hours for a full-time employee in a year.

________ This is the number of full-time hours worked.

\+ ________ ***Add*** the number of any overtime hours as well as the hours worked by other employees (part-time, temporary, seasonal)

________ ***Round*** the answer to the next highest whole number. Write the rounded number in the blank marked *Total hours worked by all employees last year.*

U.S. Department of Labor
Occupational Safety and Health Administration

OSHA's Form 301
Injury and Illness Incident Report

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary,* these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by ____

Title ____

Phone (______)_______--__________ **Date** ____/ ____/ ____

Information about the employee

1) **Full name** ____

2) **Street** ____

City ______________________________ **State** _______ **ZIP** _________

3) **Date of birth** _____ / _____ / _____

4) **Date hired** _____ / _____ / _____

5) ☐ **Male**
☐ **Female**

Information about the physician or other health care professional

6) **Name of physician or other health care professional** ____________________

____

7) **If treatment was given away from the worksite, where was it given?**

Facility ____

Street ____

City ______________________________ **State** _______ **ZIP** _________

8) **Was employee treated in an emergency room?**
☐ **Yes**
☐ **No**

9) **Was employee hospitalized overnight as an in-patient?**
☐ **Yes**
☐ **No**

Information about the case

10) **Case number from the *Log*** _________________ *(Transfer the case number from the Log after you record the case.)*

11) **Date of injury or illness** _____ / _____ / _____

12) **Time employee began work** ________________ **AM / PM**

13) **Time of event** ________________ **AM / PM** ☐ **Check if time cannot be determined**

14) ***What was the employee doing just before the incident occurred?*** **Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."**

15) ***What happened?*** **Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."**

16) ***What was the injury or illness?*** **Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."**

17) ***What object or substance directly harmed the employee?*** ***Examples:*** **"concrete floor"; "chlorine"; "radial arm saw." *If this question does not apply to the incident, leave it blank.***

18) ***If the employee died, when did death occur?*** **Date of death** _____ / _____ / _____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a current valid OMB control number. If you have any comments about this estimate or any other aspects of this data collection, including suggestions for reducing this burden, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

If You Need Help...

If you need help deciding whether a case is recordable, or if you have questions about the information in this package, feel free to contact us. We'll gladly answer any questions you have.

- **Visit us online at www.osha.gov**
- **Call your OSHA Regional office and ask for the recordkeeping coordinator**

or

- **Call your State Plan office**

Federal Jurisdiction

Region 1 - 617 / 565-9860
Connecticut; Massachusetts; Maine; New Hampshire; Rhode Island

Region 2 - 212 / 337-2378
New York; New Jersey

Region 3 - 215 / 861-4900
DC; Delaware; Pennsylvania; West Virginia

Region 4 - 404 / 562-2300
Alabama; Florida; Georgia; Mississippi

Region 5 - 312 / 353-2220
Illinois; Ohio; Wisconsin

Region 6 - 214 / 767-4731
Arkansas; Louisiana; Oklahoma; Texas

Region 7 - 816 / 426-5861
Kansas; Missouri; Nebraska

Region 8 - 303 / 844-1600
Colorado; Montana; North Dakota; South Dakota

Region 9 - 415 / 975-4310

Region 10 - 206 / 553-5930
Idaho

State Plan States

Alaska - 907 / 269-4957

Arizona - 602 / 542-5795

California - 415 / 703-5100

*Connecticut - 860 / 566-4380

Hawaii - 808 / 586-9100

Indiana - 317 / 232-2688

Iowa - 515 / 281-3661

Kentucky - 502 / 564-3070

Maryland - 410 / 527-4465

Michigan - 517 / 322-1848

Minnesota - 651 / 284-5050

Nevada - 702 / 486-9020

*New Jersey - 609 / 984-1389

New Mexico - 505 / 827-4230

*New York - 518 / 457-2574

North Carolina - 919 / 807-2875

Oregon - 503 / 378-3272

Puerto Rico - 787 / 754-2172

South Carolina - 803 / 734-9669

Tennessee - 615 / 741-2793

Utah - 801 / 530-6901

Vermont - 802 / 828-2765

Virginia - 804 / 786-6613

Virgin Islands - 340 / 772-1315

Washington - 360 / 902-5554

Wyoming - 307 / 777-7786

*Public Sector only

U.S. Department of Labor
Occupational Safety and Health Administration

U.S. Department of Labor
Occupational Safety and Health Administration

Have questions?

If you need help in filling out the *Log* or *Summary*, or if you have questions about whether a case is recordable, contact us. We'll be happy to help you. You can:

- Visit us online at: **www.osha.gov**
- Call your regional or state plan office. You'll find the phone number listed inside this cover.

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C.3

TechLaw Incident Reporting Forms

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INCIDENT REPORT

DATE OF REPORT: ______________________ ENTITY: __________________________

SITE: ____

SITE LOCATION: ____

REPORT PREPARED BY: ____
NAME PRINTED TITLE

INCIDENT CATEGORY (check all that apply)

____ Injury
____ Near miss
____ Motor vehicle
____ Mechanical
____ Illness
____ Fire
____ On-site equipment
____ Environmental damage
____ Property damage
____ Chemical exposure
____ Electrical
_____ Other

DATE AND TIME OF INCIDENT: ______________________________________

Narrative report of incident: (Provide sufficient detail so that the reader may fully understand the actions leading to or contributing to the incident, the incident occurrence, and actions following the incident. Include a description and the condition of any equipment involved. Append additional sheets of paper if necessary.)

WITNESSES TO INCIDENT

1. NAME: ______________________________COMPANY: ____________________________
ADDRESS: ____
TELEPHONE NO/EMAIL: ____

2. NAME: ______________________________COMPANY: ____________________________
ADDRESS: ____
TELEPHONE NO/EMAIL: ____

INJURIES (attach additional sheets if necessary)

Name and address of injured: ____
____
____

Age: _____ Sex: _____ Years of service: _______ Time on present job: _______

Title/Classification: ____

Part of body affected: _________________ Date medical care was received: _____________

Name/Address/Phone of Medical Facility: ____
____
____

Name/Address/Phone of Treating Physician (if known): ________________________________
____
____

Nature of injury or illness: ____
____
____

Classification of injury:

____ Fractures
____ Dislocations
____ Sprains
____ Abrasions
____ Lacerations
____ Punctures
____ Faint/dizziness
____ Respiratory allergy
____ Heat burns
____ Chemical burns
____ Radiation burns
____ Bruises
____ Blisters
____ Toxic respiratory exposure
____ Bites
____ Toxic ingestion
____ Cold exposure
____ Frostbite
____ Heat stroke
____ Heat exhaustion
____ Concussion
____ Dermal allergy
____ Other

Severity of injury:

____ Prescription(s) received
____ Restricted duty
____ Lost time

Estimated number of days restricted/lost: ____
Nature of restriction (if applicable): ____
____

PROPERTY DAMAGE

Brief description of property damaged: ____
____
____
____

Estimate of damage: $____

INCIDENT LOCATION: ____
____
____

INCIDENT ANALYSIS

Causative agent most directly related to accident (object, substance, material, machinery, equipment, conditions): ____
____
____

Was weather a factor? ____

Unsafe mechanical/physical/environmental condition at time of incident (be specific): _________
____
____

Unsafe act by injured and/or others contributing to the incident (be specific, must be answered):
____
____

Personal factors (improper attitude, lack of knowledge and/or skill, slow reaction, fatigue):
____
____
____

On-site incidents

Level of personal protection equipment required in the site Health and Safety Plan: ___________
____

Modifications: ____
____

Was the injured using required equipment? ____________________________________

If not, how did actual equipment use differ from plan? ______________________________
____

ACTION TAKEN TO PREVENT RECURRENCE (Be very specific. What has or will be done? When will it be done? Who is the responsible party to ensure that the correction is made?) _____
____
____
____
____

INCIDENT REPORT COMPLETED BY:

____________________________ ____________________________
SHSO name printed SHSO signature

OTHERS PARTICIPATING IN INVESTIGATION

____________________	____________________	____________________
Name printed	Signature	Title
____________________	____________________	____________________
Name printed	Signature	Title
____________________	____________________	____________________
Name printed	Signature	Title

INCIDENT FOLLOW-UP REPORT

Date: __________

Date of incident: ____

Site: ____

Brief description of incident: ____
____
____

Outcome of incident: ____
____
____

Status of corrective actions: ____
____
____
____

Have there been other similar incidents: ____
If yes, describe any additional corrective actions that are needed and their status:______________
____
____
____

INCIDENT FOLLOW-UP REPORT COMPLETED BY:

____________________	____________________	____________________
Name printed	Signature	Title

OTHERS PARTICIPATING IN FOLLOW-UP INVESTIGATION

____________________	____________________	____________________
Name printed	Signature	Title
____________________	____________________	____________________
Name printed	Signature	Title

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

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C.4

USACE 3394 Form

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(For safety staff only)	REPORT NO.	EROC CODE	**UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT** For use of this form, see Help Menu and USACE Supplement to AR 385-40 The proponent agency is CESO	REQUIREMENT CONTROL SYMBOL: CEEC-S-8 *(R2)*

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE		MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED	☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED	☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER			☐	

2. PERSONAL DATA

a. NAME *(Last, First MI.)*	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT ☐ ON DUTY ☐ TDY ☐ OFF DUTY	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT ☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)* ______

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(YYYYMMDD)*	b. TIME OF ACCIDENT *(Military Time)* hrs.	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME (1) PRIME
e. CONTRACT NUMBER ______ ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)* ______	f. TYPE OF CONTRACT ☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)* ______	g. HAZARDOUS/TOXIC WASTE ACTIVITY ☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)*	(2) SUBCONTRACTOR

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY (CODE) ______ #	b. TYPE OF CONSTRUCTION EQUIPMENT (CODE) ______ #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY (CODE) ______ #	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED (CODE) PRIMARY ______ # (CODE) SECONDARY ______ #	g. TYPE AND SOURCE OF INJURY/ILLNESS (CODE) TYPE ______ # (CODE) SOURCE ______ #
f. NATURE OF ILLNESS / INJURY (CODE) ______ #	

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT (CODE) ______ #	b. PERSONAL FLOTATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT					
a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT APPLICABLE
☐☐ PICKUP/VAN ☐☐ AUTOMOBILE	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END	(1) FRONT SEAT	☐	☐	☐
☐☐ TRUCK ☐☐ OTHER *(Specify)* ____________________	☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ______________	(2) REAR SEAT	☐	☐	☐

8. PROPERTY MATERIAL INVOLVED		
a. NAME OF ITEM	b. OWNERSHIP	c. AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*			
a. ACTIVITY AT TIME OF ACCIDENT ________________________	(CODE) # ☐	a. ACTIVITY AT TIME OF ACCIDENT ________________________	(CODE) # ☐

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary, see attached page 4.)*

11. CAUSAL FACTOR*(s)* *(Read instructions before completing)*

a. *(Explain YES answers in item 13)*	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?	☐	☐
b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT? *(If yes, attach a copy.)*	☐	☐

12. TRAINING		
a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK? ☐ YES ☐ NO	b. TYPE OF TRAINING ☐ CLASSROOM ☐ ON JOB	c. DATE OF MOST RECENT FORMAL TRAINING *(YYYYMMDD)*

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE*(s)* *(Attach additional sheets as needed, See page 4)*

b. INDIRECT CAUSE*(s)* *(Attach additional sheets as needed, See page 5)*

14.	ACTION*(s)* TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE*(s)*

DESCRIBE FULLY *(Attach additional sheets as necessary, See page 5)*

15.	DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING *(YYYYMMDD)*	b. ANTICIPATED COMPLETION *(YYYYMMDD)*

c. DATE SIGNED *(YYYYMMDD)*	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CORPS SIGNATURE, SUPERVISOR COMPLETING REPORT
c. DATE SIGNED *(YYYYMMDD)*	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CONTRACTOR SIGNATURE, SUPERVISOR COMPLETING REPORT

f. ORGANIZATION IDENTIFIER *(Division, Branch, Section, etc.,)*	g. OFFICE SYMBOL

16.	MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NONCONCUR c. COMMENTS

DATE *(YYYYMMDD)*	TITLE	SIGNATURE

17.	MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.,)*

a. ☐ CONCUR b. ☐ NONCONCUR c. COMMENTS

DATE *(YYYYMMDD)*	TITLE	SIGNATURE

18.	SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NONCONCUR c. ADDITIONAL ACTIONS/COMMENTS

DATE *(YYYYMMDD)*	TITLE	SIGNATURE

19.	COMMAND APPROVAL

COMMENTS

DATE *(YYYYMMDD)*	COMMANDER SIGNATURE

10. ACCIDENT DESCRIPTION *(Continuation)*

13a. DIRECT CAUSE*(s) (Continuation)*

13b. INDIRECT CAUSE*(s)* *(Continuation)*

14. ACTION*(s)* TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE*(s)* *(Continuation)*

GENERAL. Complete a separate report for each person who was injured, caused, or contributed to the accident *(excluding uninjured personnel and witnesses)*. Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs *(OWCP)* shall be at the discretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16 and 17.

INSTRUCTIONS FOR SECTION 1 - ACCIDENT CLASSIFICATION

(Mark All Boxes That Are Applicable)

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 *(injury)*, CA-2 *(illness)* or CA-6 *(fatality)* to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to government property *(including motor vehicles)*.

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any contractor lost-time injury/illness or fatality.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to contractor property *(including motor vehicles).*

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in public fatality or permanent total disability. *(The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander)*.

(2) VOID SPACE - Make no entry.

(3) VEHICLE INVOLVED - Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE - Make no entry.

INSTRUCTIONS FOR SECTION 2 - PERSONAL DATA

a. NAME - *(MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS)*. Enter last name, first name, middle initial of person involved.

b. AGE - Enter age.

c. SEX - Mark appropriate box.

d. SOCIAL SECURITY NUMBER - *(FOR GOVERNMENT PERSONNEL ONLY*) Enter the social security number *(or other personal identification number if no social security number issued)*.

e. GRADE - *(FOR GOVERNMENT PERSONNEL ONLY)* Enter pay grade. Example: 0-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE - For government civilian employees enter the pay plan, full series number, and job title, e.g., GS-O810/Civil Engineer. For military personnel enter the primary military occupational specialty *(PMOS)*, e.g., 15A30 or 11G50. For contractor employees enter the job title assigned to the injured person, e.g., carpenter, laborer, surveyor, etc.

g. DUTY STATUS - Mark the appropriate box.

(1) ON DUTY - Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident.

h. EMPLOYMENT STATUS - *(FOR GOVERNMENT PERSONNEL ONLY)* Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 - GENERAL INFORMATION

a. DATE OF ACCIDENT - Enter the month, day, and year of accident.

b. TIME OF ACCIDENT - Enter the local time of accident in military time. Example: 1430 hrs *(not 2:30 p.m.)*.

c. EXACT LOCATION OF ACCIDENT - Enter facts needed to locate the accident scene, *(installation/project name, building number, street, direction and distance from closest landmark, etc.)*.

d. CONTRACTOR NAME

(1) PRIME - Enter the exact name *(title of firm)* of the prime contractor.

(2) SUBCONTRACTOR - Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER - Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY *(HTW)* - Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program *(IRP)* HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site *(FUDS)* activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 - CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY - Select the most appropriate construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION
2. SITE PREPARATION
3. EXCAVATION/TRENCHING
4. GRADING (EARTHWORK)
5. PIPING/UTILITIES
6. FOUNDATION
7. FORMING
8. CONCRETE PLACEMENT
9. STEEL ERECTION
10. ROOFING
11. FRAMING
12. MASONRY
13. CARPENTRY
14. ELECTRICAL
15. SCAFFOLDING/ACCESS
16. MECHANICAL
17. PAINTING
18. EOUIPMENT/MAINTENANCE
19. TUNNELING
20. WAREHOUSING/STORAGE
21. PAVING
22. FENCING
23. SIGNING
24. LANDSCAPING/IRRIGATION
25. INSULATION
26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT - Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE *(ON VESSEL/BARGE)*
4. CRANE *(TRACKED)*
5. CRANE *(RUBBER TIRE)*
6. CRANE *(VEHICLE MOUNTED)*
7. CRANE *(TOWER)*
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK *(CONCRETE)*
11. TRUCK *(CONCRETE/TRANSIT MIXER)*
12. DUMP TRUCK *(HIGHWAY)*
13. DUMP TRUCK *(OFF HIGHWAY)*
14. TRUCK *(OTHER)*
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR *(UTILITY)*
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5 - INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY/ILLNESS - Reference paragraph 2-10 of USACE Supplement 1 to AR 385-40 and enter code and description from list below.

NOI	NO INJURY
FAT	FATALITY
PTL	PERMANENT TOTAL DISABILITY
PPR	PERMANENT PARTIAL DISABILITY
LWD	LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW	RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA	RECORDABLE FIRST AID CASE
NRI	NON-RECORDABLE INJURY

b. ESTIMATED DAYS LOST - Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED - Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED - Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCKS	LB	BOTH LEGS/HIPS/ ANKLES/ BUTTOCK
	LS	SINGLE LEG/HIP/ ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM *(BREAST BONE)*
	RV	VERTEBRAE *(SPINE; DISC)*
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury/illness from the list below. This nature of injury/illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury/illness name on the line and place the corresponding CODE letters in the box provided.
* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN
	TC	CONTUSION; BRUISE; ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/INFECTIVE/ PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER, STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY - OTHER *(EXCEPT DISEASE, ILLNESS)*

** A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	**CODE**	**NATURE OF INJURY NAME**
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES		
	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC - OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE *(OTHER THAN CODE TYPES R&S)*
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS, NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER
SKIN DISEASE OR CONDITION		
	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS *(CAUSE)* - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident *(see example 1, below)*. Examples:

(1) An employee tripped on carpet and struck his head on a desk. TYPE: 210 *(fell on same level)* SOURCE: 0110 *(walking/working surface)*.

NOTE: This example would NOT be coded 120 *(struck against)* and 0140 *(furniture)*.

(2) A Park Ranger contracted dermatitis from contact with poison ivy/oak.

TYPE: 510 *(contact)* SOURCE: 0920 *(plant)*

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.

TYPE: 410 *(punctured by)* SOURCE: 0830 *(metal)*

(4) An employee was driving a government vehicle when it was struck by another vehicle.

TYPE: 800 *(traveling in)* SOURCE: 0421 *(government-owned vehicle, as driver)*

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	**TYPE OF INJURY NAME**
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED *(NO FALL)*
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH *(INJURED PERSON MOVING)*
0520	CONTACTED BY *(OBJECT WAS MOVING)*
	EXERTED
0610	LIFTED, STRAINED BY *(SINGLE ACTION)*
0620	STRESSED BY *(REPEATED ACTION)*
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	**SOURCE OF INJURY NAME**
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE *(FLOOR, STREET, SIDEWALKS, ETC.)*
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT *(ERGONOMIC)*
0170	WINDOWS, DOORS
0180	ELECTRICITY

0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME *(INDOOR)*
0220	WEATHER *(ICE, RAIN, HEAT, ETC.)*
0230	FIRE, FLAME, SMOKE *(NOT TOBACCO)*
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS *(EMOTIONAL)*
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL *(POWERED; SAW, GRINDER, ETC.)*
0320	HAND TOOL *(NONPOWERED)*
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD *(FIXED, MOVEABLE, INTERLOCK)*
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER *(AIRLINE, BUS, ETC.)*
0440	AIRCRAFT *(NOT COMMERCIAL)*
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER *(TRACTOR, BACKHOE, ETC.)*
0520	CONVEYOR *(FOR MATERIAL AND EQUIPMENT)*
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST *(SILICA, COAL, ETC.)*
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES *(UNIDENTIFIED)*
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL - CORROSIVE
0712	DRY CHEMICAL - TOXIC
0713	DRY CHEMICAL - EXPLOSIVE
0714	DRY CHEMICAL FLAMMABLE
0721	LIQUID CHEMICAL - CORROSIVE
0722	LIQUID CHEMICAL - TOXIC
0723	LIQUID CHEMICAL - EXPLOSIVE
0724	LIQUID CHEMICAL - FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INAMINATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN *(VIOLENCE)*
0950	HUMAN *(COMMUNICABLE DISEASE)*
0960	BACTERIA, VIRUS *(NOT HUMAN CONTACT)*
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 - PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT - Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the most appropriate primary activity area *(water related, non-water related or other activity)*, the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating-powered
3. Boating-unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities *(skin diving, scuba, etc.)*
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing *(general)*
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer *(baseball, football, etc.)*
24. Sports/winter *(skiing, sledding, snowmobiling etc.)*
25. Cycling *(bicycle, motorcycle, scooter)*
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts *(fights, riots, vandalism, etc.)*
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED - If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7 - MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE - Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION - Mark appropriate box.

c. SEAT BELT - Mark appropriate box.

INSTRUCTIONS FOR SECTION 8 - PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM - Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number *(NSN)* whenever applicable.

b. OWNERSHIP - Enter ownership for each item listed. *(Enter one of the following: USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)*

c. $ AMOUNT OF DAMAGE - Enter the total estimated dollar amount of damage *(parts and labor)*, if any.

INSTRUCTIONS FOR SECTION 9 - VESSEL/FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT - Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL, BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP - Select from the list below the object*(s)* that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEPT DOWN 0N DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10 - ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT - Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role*(s)* in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11 - CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE - Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES - Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES - Were any of the provisions of the Safety and Health Requirements Manual *(EM 385-1-1)* violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice *(including EM 385-1-1)* fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS - Was the person under undue stress *(either internal or external to the job)*? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS - Did exposure to chemical agents *(either single shift exposure or long-term exposure)* such as dusts, fibers *(asbestos, etc.)*, silica, gases *(carbon monoxide, chlorine, etc.,)*, mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation *(UV radiation created during welding, etc.)* contribute to the accident/incident?

(9**)** OFFICE FACTORS **-** Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) SUPPORT FACTORS - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources *(in terms of employee skills, number of workers, and adequate supervision)* available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc.?

(11) PERSONAL PROTECTIVE EQUIPMENT - Did the person fail to use appropriate personal protective equipment *(gloves, eye protection, hard-toed shoes, respirator, etc.)* for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard*(s)*? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS - Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12 - TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK? - For the purpose of this section "trained" means the person has been provided the necessary information *(either formal and/or on-the-job (OJT) training)* to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING - Mark the appropriate box that best indicates the type of training; *(classroom or on-the-job)* that the injured person received, before the accident happened.

c. DATE OF MOST RECENT TRAINING - Enter YYYYMMDD of the last formal training completed that covered the activity task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13 - CAUSES

a. DIRECT CAUSES - The direct cause is that single factor, which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES - **I**ndirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.

Direct cause: failure to provide fall protection at elevation. Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee *(possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety)*; failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. *(Note: USACE vehicle was in proper/safe working condition).*

Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.

Indirect cause: failure of employee to pay attention to driving *(defensive driving).*

INSTRUCTIONS FOR SECTION 14 - ACTION TO ELIMINATE CAUSE*(s)*

DESCRIPTION - Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/ illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15 - DATES FOR ACTION

a. **BEGIN DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will begin.

b. **COMPLETE DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will be completed.

c. **DATE SIGNED** - Enter YYYYMMDD that the report was signed by the responsible supervisor.

d.e.. **TITLE AND SIGNATURE -** Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE supervisor shall also sign the report. Upon entering the information required in 15c., 15d., 15e., 15f. and 15g. below, the responsible USACE supervisor shall forward the report for management review as indicated in section 16.

f. **ORGANIZATION NAME** - For GOVERNMENT employee accidents enter the USACE organization name *(Division, Branch, Section, etc.)* of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15d. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

g. **OFFICE SYMBOL** - Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15f.

INSTRUCTIONS FOR SECTION 16 - MANAGEMENT REVIEW (1st)

1ST REVIEW - Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15d. shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief *(2nd review)* for review and comment.

INSTRUCTIONS FOR SECTION 17 - MANAGEMENT REVIEW (2nd)

2ND REVIEW - The FOA Staff Chief *(i .e., FOA Chief of Construction, Operations, Engineering, Planning, etc.)* shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18 - SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW - The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19 - COMMAND APPROVAL

4TH REVIEW - The FOA Commander shall *(to include the person designated Acting Commander in his absence)* review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

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APPENDIX B

ENVIRONMENTAL PROTECTION PLAN

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ENVIRONMENTAL PROTECTION PLAN

LHAAP-17, BURNING GROUND NO.2/FLASHING AREA, GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Prepared for

United States Army Corps of Engineers,
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

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Table of Contents

List of Acronyms and Abbreviations

BRAC	Base Realignment and Closure
COR	Contracting Officer’s Representative
DGM	digital geophysical mapping
DOT	United States Department of Transportation
EPCRA	Emergency Planning and Community Right-to-Know Act
EPP	Environmental Protection Plan
ESA	Endangered Species Act
GPS	Global Positioning System
IAW	in accordance with
LHAAP	Longhorn Army Ammunition Plant
MEC	Munitions and Explosives of Concern
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC – TLI Solutions Joint Venture
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
PM	Project Manager
RDW	remediation-derived waste
SOP	Standard Operating Procedure
TAC	Texas Administrative Code
TLI	TLI Solutions
TPWD	Texas Department of Parks & Wildlife
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WMP	Waste Management Plan

1. INTRODUCTION

This Environmental Protection Plan (EPP) describes the site-specific procedures and methods to be employed to minimize pollution, protect and conserve natural resources, restore damage, and control dust within reasonable limits during performance of all tasks associated with the field activities detailed in the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) to implement a Time Critical Removal Action for Munitions and Explosives of Concern (MEC) at LHAAP-17 Burning Ground No. 2/Flashing Area Group 2 (hereinafter LHAAP-17) at Longhorn Army Ammunition Plant (LHAAP), Texas. All field activities will be conducted in a manner to disturb only those areas that are necessary, and to minimize impacts and limit disturbances to the smallest practical area.

2. AVOIDANCE OF THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

There are no known Federal Endangered Species Act (ESA)-protected animal or plant species on LHAAP, however there are 22 animal species that could potentially be present on or near LHAAP that appear on federal or state Threatened and Endangered species lists. Although no longer protected under the Federal ESA, the bald eagle remains protected under the Federal Bald and Golden Eagle Protection Act and bald eagles are known or suspected to occur in the vicinity of LHAAP. Of the 22 animal species that could potentially be present, information received from United States Fish and Wildlife Service (USFWS) and Texas Department of Parks and Wildlife (TPWD) identified the following list of endangered and threatened species that are known or suspected to occur in the vicinity of LHAAP (species that have been confirmed at LHAAP are listed in bold):

Federal Listed Endangered Species:
– **Red-cockaded Woodpecker**
– **Wood Stork**

Federal Listed Threatened Species:
– **American Alligator**
– Piping Plover
– Arctic Peregrine Falcon
– **Bald Eagle**

State Listed Endangered Species:
– Paddlefish
– **Louisiana Pine Snake**
– Louisiana Black Bear

State Listed Threatened Species:
– Blackside Darter
– Creek Chubsucker
– Blue Sucker
– Texas Horned Lizard
– Eastern Big-Eared Bat
– **Alligator Snapping Turtle**
– **Canebrake Rattlesnake**
– Northern Scarlet Snake
– White-faced Ibis
– American Swallow-tailed Kite
– **Bachman’s Sparrow**
– **River Otter**

- Bluehead Shiner

State Species of Concern:
- Southern Lady's Slipper

State Special Features/Natural Communities/Managed Areas:
- Colonial Waterbird Rookeries
- Bald Cypress-Water Tupelo Series
- Shortleaf Pine-Oak Series
- Water Oak-Willow Oak Series
- Caddo Lake State Park

Despite the endangered or threatened status of the species described above, no critical habitat exists at LHAAP (USFWS, 2020). In the event that a threatened/endangered species is observed, field teams will avoid it to prevent disturbance of the individual. In most cases, survey transects can readily be adjusted to avoid disturbance. In addition to avoidance measures, the species will be photographed (if possible) and reported on the same day to the Munitions Management Group, LLC (MMG)-TLI Solutions (TLI) Joint Venture (MMG-TLI JV) Project Manager (PM), who will contact a project biologist for species confirmation. Any such observations will be documented via email to the appropriate stakeholders.

3. WATER RESOURCES PROTECTION

Minimal amounts of chemicals will be brought on site during field activities. Field activities will minimize or prevent generating contaminated soils, water or waste during this project. Therefore, no run-on or run-off water controls will be necessary.

4. SPILL CONTROL AND PREVENTION

Light truck or utility vehicles will be fueled at commercial filling stations that are designed to prevent and control potential spills. No refueling of light truck or utility vehicles will be conducted on-site.

For equipment that must be fueled on-site, such as an excavator, fuel will be purchased at commercial filling stations in United States Department of Transportation (DOT)-approved fuel cans, and the equipment will be filled on-site on a leak-proof surface, such as a plastic or metal-lined tray, whenever possible. A spill kit will be maintained on-site, and personnel will be trained to use the kit. If spills do occur when refueling equipment, they will be immediately cleaned up, and the materials will be contained.

To mitigate the spread of contaminants, trucks and/or containers hauling contaminated soils will be tarped or otherwise covered before transport.

MMG-TLI JV will adhere to the spill response procedure outlined in Appendix A, Site Safety and Health Plan.

5. CONTROL OF WATER RUN-ON AND RUNOFF

Average total monthly precipitation and temperatures are provided below (NOAA, 2020). Field activities are planned for September through November 2021.

Month	Monthly Precipitation (inches)	Average High (degrees Fahrenheit [°F])	Average Low (°F)
January	2.8	59	33
February	3.4	61	37

Month	Monthly Precipitation (inches)	Average High (degrees Fahrenheit [°F])	Average Low (°F)
March	4.1	71	44
April	4.5	78	51
May	3.7	85	60
June	3.3	92	68
July	2.5	95	70
August	2.8	95	70
September	3.3	90	62
October	2.8	80	51
November	2.4	68	41
December	2.7	60	36

Soil disturbance associated with MEC intrusive activities will be localized, and soils will be returned to these localized excavations as quickly as possible to reduce the impact of run-on/runoff. Areas with slope greater than 30 degrees will be avoided, and no work will be performed during periods of heavy rainfall, therefore sediment control concerns are not anticipated. Field crews will be attentive to sediment runoff and will implement appropriate controls (e.g., silt fencing), if necessary, to avoid sediment runoff to sensitive areas.

In the event that construction activities disturb equal to or greater than one acre of land, MMG-TLI JV will comply with the substantive requirements of a USEPA National Pollutant Discharge Elimination System (NPDES) general permit (40 Code of Federal Regulations (CFR) 122.26; 30 Texas Administrative Code (TAC) 205, Subchapter A; and 30 TAC 308.121). However, the currently anticipated area of disturbance associated with the munitions response activities detailed in the UFP-QAPP is less than one acre.

MMG-TLI JV will implement good construction management techniques; minimize clearing; and implement sediment, erosion, structural, and vegetative controls to mitigate runoff and ensure that discharges meet required parameters.

Munitions response activities cannot be accomplished safely in ponded or standing water. Impounded water in open excavations will be managed IAW Attachment 1, Memorandum for Record, Release of Impounded Water from Open Excavation Pits at LHAAP-17, LHAAP, Karnack, TX. Procedures will be consistent with previously approved protocol, including but not limited to the protocol for discharging GWTP effluent (Attachment 2, Memorandum, Protocol for Discharging GWTP Effluent Longhorn Army Ammunition Plant, Karnack, TX), as applicable.

6. DUST AND EMISSION CONTROL

Fugitive dust generated during munitions response activities in support of the remedy is anticipated to be minimal. Dust generating activities are anticipated to include small excavations to remove subsurface anomalies identified as targets of interest based on the results of geophysical survey, light truck or utility vehicle operation, and on-site detonation of MEC if MEC is recovered.

Airborne particulate matter resulting from construction or excavation activities is subject to the fugitive dust and opacity limits listed in 30 TAC 111, Subchapter A. No person may cause, suffer, allow, or permit visible emissions from any source to exceed an opacity of 30 percent for any six-minute period (30 TAC 111.111[a]). Reasonable precautions will be taken to achieve maximum control of dust to the extent practicable, including the application of water or suitable chemicals or the complete covering of materials (30 TAC 111.143 and 30 TAC 111.145). Texas has promulgated general nuisance rules for air contaminants mandating that no person shall discharge from any source whatsoever one or more air contaminants, or combinations thereof, in such concentration and of such duration as are or may tend to be injurious to or to adversely affect human health or welfare, animal life, vegetation, or property, or as to interfere with the normal use and enjoyment of animal life, vegetation, or property (30 TAC 101.4).

Light truck or utility vehicles will be used to transport field staff or move supplies and equipment and vehicle traffic will be on existing roadways and the access roads. When driving on gravel roads, all vehicles will be operated at low speeds to reduce the amount of dust generated. To reduce auto emissions, vehicles will be turned off when not in operation.

7. EXPENDITURE TRACKING AND REPORTING

The quantity and type of all MEC disposed of and all donor explosives used will be tracked and provided, (upon request) or at a minimum at the end of field activities, to the Base Realignment and Closure (BRAC) Site Manager for use in Emergency Planning and Community Right-to-Know Act (EPCRA) reporting.

8. AVOIDANCE OF CULTURAL AND ARCHAEOLOGICAL RESOURCES

Numerous archaeological sites and historic cemeteries have been identified on LHAAP representing prehistoric through historic periods. Twenty-seven of those sites were evaluated and found eligible for protection or inclusion in the National Register of Historic Places (NRHP). The National Historic Preservation Act Section 106 mandates that Federal agencies consider the effects of Federally funded and permitted undertakings on historic resources listed in or eligible for listing in the NRHP (16 United States Code (USC) 470). Activities on LHAAP must comply with terms and conditions of Section 106 of the National Historical Preservation Act. MMG-TLI JV, in coordination with the BRAC Site Manager, will contact the USFWS for remedial actions that will impact natural resources at LHAAP.

Cultural and archeological resources (artifacts, features, and sites) are not anticipated to be encountered, and an archaeologist is not anticipated to be necessary to support field activities. Field personnel will be briefed during the entry briefing on the visual appearance of any potential cultural/archeological resources, if any. If potential cultural/archeological resources are encountered during the field effort, MMG-TLI JV will immediately notify the BRAC Site Manager. Items will be photographed, the location will be recorded with Global Positioning System (GPS), and notes will be taken to describe the finding and overall condition. Confirmed cultural resource items will be removed only if necessary to maintain the integrity of the munitions response and upon approval of the BRAC Site Manager and the United States Army Corps of Engineers (USACE).

9. ESTABLISHMENT OF TEMPORARY FACILITIES

Temporary facilities will be utilized by the MMG-TLI JV project team. These temporary facilities are anticipated to consist of a portable toilet(s), a field office, and an MEC storage magazine in support of munitions response field activities. Locations of these facilities will be coordinated with the BRAC Site Manager. All temporary facilities will be completely removed at the end of planned field activities, and the site will be restored using approved native grass seed mix, as appropriate.

10. ACCESS ROUTES

The construction of temporary access routes is not anticipated for this project. Existing roadways and access routes will be used. MMG-TLI JV will coordinate with the Contracting Officer's Representative (COR) and BRAC Site Manager to gain access to available infrastructure (e.g., buildings, roadways, waste management units, other Installation facilities) and utilities (e.g., electric power and telephone lines, natural gas and water supply distribution pipelines, and wastewater discharge conveyances), to execute the field activities at LHAAP. MMG-TLI JV will coordinate with the BRAC Site Manager for access to the installation through Caddo Lake National Wildlife Refuge, if needed.

11. VEGETATION REMOVAL AND PROTECTION

MMG-TLI JV will take all actions to avoid unnecessary damage to vegetation at LHAAP. Vegetation will be disturbed only where necessary to support field activities. No trees larger than 2 inches in diameter will be removed unless coordinated with the BRAC Site manager. Vegetative waste will be left on site.

Vegetation, which consists primarily of brush and grasses, will be removed to complete surface clearance of the site, as necessary to support digital geophysical mapping (DGM) activities. Vegetation/brush removal will be limited to the planned DGM transects and performed by the UXO team observing MEC/anomaly avoidance with mechanized equipment (e.g., brush hog) and appropriate hand tools. Mechanized equipment will first be used to cut grass/small shrubs to a height of 6 inches. Large shrubs and/or new growth trees will be cut to 6 inches in height with hand tools to avoid breaking/impacting the ground surface for safety and, as needed to further facilitate use of digital sensors. Root masses of brush and vegetation will remain in the ground to promote regrowth and prevent erosion runoff from the area.

12. EQUIPMENT DECONTAMINATION

MMG-TLI JV will ensure all equipment has been previously decontaminated before being brought on the site. Once on site, each vehicle (e.g., excavator) in direct contact with excavated soils will undergo dry decontamination measures prior to leaving the work sites. Whenever possible, dry decontamination methods will be used for affected project equipment. Equipment decontamination during field activities will be in accordance with (IAW) Appendix B, Standard Operating Procedure (SOP) Number 02-03-06. Remediation-derived waste (RDW) will be managed and disposed of IAW Appendix B, SOP Number 02-04-05 and Appendix F, Waste Management Plan (WMP).

Disposable sampling equipment will be used whenever possible.

13. DAMAGE RESTORATION

During the field activities, care will be taken to prevent damage to the equipment used, the property located in and adjacent to LHAAP-17, and the environment.

MMG-TLI JV will restore any property damage to a condition matching adjacent areas. Each intrusive excavation and sampling location will be restored to match pre-excavation/sampling conditions and/or to the satisfaction of the BRAC Site Manager. All stakes emplaced will be removed and any damage to work areas, roads or trail systems will be repaired.

14. MINMIZING AREAS OF DISTURBANCE

Reasonable efforts will be made to avoid disturbing natural resources. To the extent practical, areas affected by the project will be restored to a near-natural condition (one that does not detract from the overall appearance of the site). In areas where earth has been moved for demolition activities, site restoration may be necessary. MMG-TLI JV will remove any temporary facilities and implement erosion control measures such as seeding, mulch, sodding, and erosion control fabrics; restore roads, structures and utilities; and plant trees, shrubbery, grasses and other vegetation, where deemed necessary.

15. BURNING ACTIVITIES

No burning activities are expected during this project.

16. REFERENCES

Performance Work Statement (PWS), 2020.

The Weather Channel, 2020 (https://weather.com/weather/monthly/l/Karnack+TX?canonicalCityId=b13ff5aa71e3b9b522dd28dc574082236aaebd3888cfa918269e4f41ba3ba25f)

National Oceanic and Atmospheric Administration (NOAA), 2020 (https://w2.weather.gov/climate/index.php?map=2&date=20201026)

US Fish and Wildlife Service, 2020 (https://ecos.fws.gov/ecp/report/species-listings-by-current-range-county?fips=48203)

ATTACHMENT 1

IMPOUNDED WATER MEMORANDUM FOR RECORD

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MMG
TLI
JOINT VENTURE

MEMORANDUM FOR RECORD

DATE: 14 April 2021

PROJECT NAME: Military Munitions Response Program, Environmental Remediation Services at LHAAP-17, Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas

SUBJECT: **Release of Impounded Water from Open Excavation Pits at LHAAP-17, LHAAP, Karnack, TX**

INTRODUCTION

This memorandum documents the process for managing impounded water from open excavation pits H, J, K, L, M and N (**Figure 1**) throughout munitions and explosives of concern (MEC) and soil removal activities at LHAAP-17. Generally, open excavations are less than 3 feet deep. However, Areas H, J and M have open excavations that are greater than 7 feet deep and could have both precipitation and groundwater accumulation.

To aid in developing water management strategies for open excavations at LHAAP-17, samples were collected from each of the open excavations H, J, K, L, M and N on 19 November 2020. Each sample was analyzed for volatile organic compounds (VOCs), explosives and perchlorate. The results were compared to the appropriate screening criteria as presented in **Table 1.** VOCs and explosives were not detected in any of the samples. Perchlorate was detected in each of the samples; however, only Area H had detections above the protective concentration level (PCL) of 17 micrograms per liter (µg/L). It should be noted that the original Area H sample was visibly turbid.

Based on the exceedance of perchlorate in Area H, two samples were collected from Area H standing water on 25 January 2021. These results were also compared to the appropriate screening criteria as presented in **Table 1**. Prior to containing these samples for analysis, the water was allowed to settle for 24 hours to duplicate planned water management processes in the field using a frac tank or similar. One sample was filtered with a 0.2 micron filter per the method in the field. In this sample, perchlorate was detected at 1.53 µg/L. The second sample was filtered in the laboratory using a 10 micron filter (no filtering in the field). In this sample, perchlorate detected was detected at 3.07 µg/L. The detected perchlorate concentrations in both Area H water samples, following settling, were less than the PCL.

Discharge to Ground

Water collected within the open excavations that is verified to not exceed the PCL for perchlorate, nor the screening criteria for VOCs and explosives (i.e., Areas J, K, L and M), will be allowed to discharge directly to ground. Based on the topography, the area north of the open excavations will be used for discharge of the impounded water. This northern area of the site is a high point. **Figure 1** presents the discharge area and excavated areas of LHAAP-17 with standing water.

Caution will be taken to not create surface water runoff. The applied rate of discharge will be determined in the field, but will be completed to ensure that water is able to percolate into the ground.

The water will not be allowed to sheet flow into ditches, creeks or other surface water bodies. Due to the volume of water in the open excavations, pumping will be stopped periodically to allow water to absorb into the ground. Water will be discharge via a hose. However, a sprinkler system may be installed to increase rate of discharge without creating surface water runoff. **Table 1** presents the results from the analytical testing, which is the basis of the decision to allow these four areas to discharge to ground.

Settling of Solids Followed by Discharge to the Ground

Based on the analytical results from the original, unsettled impounded water within open excavations H, J, K, L and M, the only contaminant of concern (COC) detected above the screening criteria is perchlorate in Area H. The post-settling perchlorate results from the samples taken from Area H demonstrates that allowing solids to settle will reduce the perchlorate concentration in the water. Therefore, the impounded water from Area H will be pumped into a storage tank (e.g., frac tank) to allow for at least 24 hours of settling prior to discharge to ground as discussed above. Discharge water will be from the top of the tank to allow this similar decanting to occur. As the area is backfilled, water may be sampled to support direct discharge, if appropriate and with USACE and Regulatory approvals. Otherwise, settling will be used to ensure that water impounded in Area H does not contain perchlorate at detectable levels above the PCL. Solids that collect at the bottom of the tank will be dried out and then disposed of with the soil excavated from the site.

Backfilling

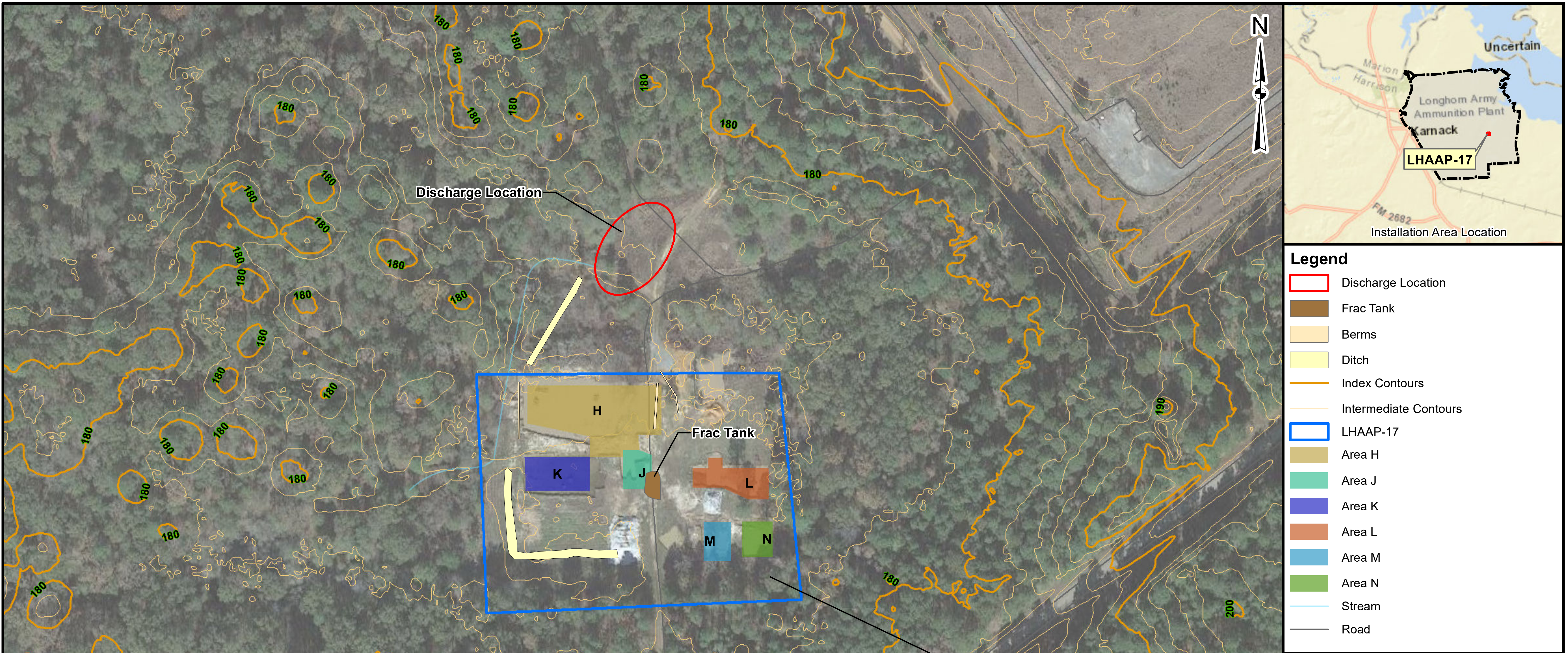
Ultimately, water management will be minimized once backfilling can occur. Therefore, those portions of the excavations that are confirmed to meet the soil screening criteria on the sidewalls and floor will be backfilled as soon as practical once Regulator approval is received.

Due to the continued saturation in excavations that may be receiving groundwater, gravel or similar will be used to a depth of 5 feet below the ground surface. Soils will be used to within 6-inches of ground surface. Then a top soil will be placed to grade to allow vegetation to grow.

Two of the 3 extraction wells for the remediation of the groundwater are located over 150 lateral feet away from the excavation footprints. The third proposed extraction well 17WW02 is located within the north side of the Area H excavation. The use of gravel will not significantly impact the follow-on extraction system performance due to both the distance of wells from the excavation and the depth of the well pump placement. Proposed extraction well 17WW02 is screened 15 to 25 feet below top of casing (btoc), with depth of water recorded at 9 feet btoc. The groundwater extraction point will be approximately 10 feet below the floor of the excavation.

Conclusions

This technical memorandum provides water management process for the open excavations until the site is backfilled. Based on the water samples collected and analyzed from each area, the approach to water management is compliant with state and federal regulations that govern LHAAP as well as existing work plans.



Longhorn Army Ammunition Plant
Karnack, Texas
Memorandum for Record –
Excavation Stormwater Discharge Plan

Figure 1:
Excavation Stormwater Discharge Location

Drawn: R Buttrey
Date: 2/10/2021

MMG
TLI
JOINT VENTURE

0 75 150 300
Feet

Service Layer Credits: Google satellite imagery

Document Path: C:\Ray\TLI Solutions\Longhorn\Maps\Technical_Memorandum\Fig-1_Excavation_Stormwater_Discharge_Location.mxd

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Table 1. LHAAP 17 Standing Water in Excavations

Location ID: Sample Date:	Units	Screening Criteria	LHAAP 17_111920_H	LHAAP 17_111920_J	LHAAP 17_111920_K	LHAAP 17_111920_L	LHAAP 17_111920_M	LHAAP 17_111920_N	LHAAP17_012521_H1	LHAAP17_012521_H2 (10 micron filter)
		Sample Date	**11/19/2020**						**1/25/2021**	
		Lab Package	**HS20111074**		**HS20111080**				**HS21011069**	
Volatile Organic Compounds (8260C)		**MCL**								
1,1-Dichloroethene	µg/L	7	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	NA	NA
1,2-Dichloroethane	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	NA	NA
cis-1,2-Dichloroethene	µg/L	70	< 0.5 UJ	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	NA	NA
Trichloroethene	µg/L	5	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	NA	NA
Vinyl chloride	µg/L	2	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	NA	NA
Explosives (SW8330A)		**MSC**								
2,4,6-Trinitrotoluene	µg/L	51	< 0.770 U	< 0.139 U	< 0.0200 U	< 0.0470 U	< 0.0670 U	< 0.293 U	NA	NA
2,4-Dinitrotoluene	µg/L	0.42	< 0.385 U	< 0.0693 U	< 0.0100 U	< 0.235 U	< 0.0335 U	< 0.146 U	NA	NA
2,6-Dinitrotoluene	µg/L	0.42	< 0.770 U	< 0.139 U	< 0.0200 U	< 0.0470 U	< 0.0670 U	< 0.293 U	NA	NA
Perchlorate (E6850)		**PCL**								
Perchlorate	µg/L	17	**53.6**	**1.37**	**0.684**	**0.0738 J**	**0.0881 J**	**0.0659 J**	**1.53**	**3.07**

Blue Highlighting Indicates concentrations above the MCL/MSC/PCL

MCL/MSC - Maximum Contaminant Limit/Medium-Specific Concentrations

µg/L - micrograms per liter

J - Estimated: Between the method detection limit and reporting limit and/or due to discrepancies in meeting certain analyte-specific quality control criteria.

UJ - The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected: The analyte was analyzed for, but not detected.

PCL – Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level

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ATTACHMENT 2

PROTOCOL FOR DISCHARGING GWTP EFFLUENT

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MEMORANDUM

DATE: August 28, 2017

PROJECT NAME: Remediation of Multiple Sites, Longhorn Army Ammunition Plant, Karnack, TX

TO:	Richard Mayer	Senior Project Engineer US Environmental Protection Agency Federal Facilities Section (6PD-F)
	April Palmie	Project and Grant Manager Superfund Section, Remediation Division Texas Commission on Environmental Quality
FROM:	Rose M. Zeiler, Ph.D.	Longhorn AAP Site Manager

SUBJECT: **Protocol for Discharging GWTP Effluent**
Longhorn Army Ammunition Plant, Karnack, TX
(Contract: W912DY-09-D-0059, Task Order DS01)

INTRODUCTION

The purpose of this memo is to document the protocol for discharging Longhorn Army Ammunition Plant groundwater treatment plant (GWTP) effluent to Harrison Bayou, the INF-Pond, or LHAAP-18/24.

The GWTP is designed to:

- Extract groundwater from LHAAP-18/24 and LHAAP-16 for hydraulic control;
- Remove metals by pH adjustment, polymer addition, and gravity separation;
- Remove volatile organic compounds (VOCs) by air stripping;
- Remove perchlorate in a fluidized bed reactor (FBR) and an ion exchange scavenger system; and
- Discharge the effluent continuously.

DISCHARGE CRITERIA

The discharge criteria established for discharge to Harrison Bayou are:

Parameter	Discharge Criteria (µg/L)	
	Daily Average	Daily Maximum
Volatiles		
1,1,1-Trichloroethane	3,417	7,230
1,1,2-Trichloroethane	102.5	216.9
1,1-Dichloroethane	6,633	14,032
1,1-Dichloroethene	119	253
1,2-Dichloroethane	85	181
Acetone	1,132	2,395
Benzene	85	181
Carbon Tetrachloride	85	181
Chlorobenzene	22,300	47,180
Chloroform	1,708	3,615
Ethylbenzene	26,954	57,025
Xylenes	39.5	83.6
Methylene Chloride	803	1,699
Styrene	2,829	5,987
Tetrachloroethene	85.4	180.7
Toluene	1,980	4,189
Trichloroethene	85	181
Vinyl Chloride	34	72
Anions		
Chloride	*	*
Sulfate	*	*
Perchlorate**	278	589
Metals		
Aluminum	777	1,644
Arsenic	365	772
Barium	1,000	2,000
Cadmium	1.6	3.4
Chromium, Total	355	752
Chromium, Hexavalent	58	124
Cobalt	5,433	11,495
Iron	1,132	2,395
Lead	2.2	4.6
Nickel	87	184
Manganese	7,323	15,494
Silver	1.4	3
Selenium	5.7	12
Vanadium	1,698	3,592
Zinc	146	310
Other		
Hexachlorobenzene	0.22	0.47
1,4-Dioxane		134.2
Oil and Grease		15
Chemical Oxygen Demand		200

* - Based upon flow in Harrison Bayou

** - Discharge criteria, when diverted to the INF Pond, is 17 µg/L

PROTOCOL FOR DISCHARGING GWTP EFFLUENT

In accordance with the *Sampling and Analysis Plan, Groundwater Treatment Plant and Well Fields* (SAP) Table 2-2, indicator parameters for the FBR, such as temperature, pH and oxidation reduction potential (ORP), are monitored in real time to predict FBR performance and perchlorate removal. Based upon these indicator parameters, the operator of the GWTP can make adjustments such as:

- Bring the ion exchange system online;
- Increase or decrease the addition rate of electron donor (acetic acid);
- Increase or decrease the nutrient addition rate (urea or phosphoric acid); or
- Increase or decrease the FBR recirculation rate

Samples of the GWTP effluent are collected weekly, analyzed for perchlorate, nutrients (ammonia-nitrogen and ortho-phosphate), total organic carbon (TOC), chloride, and sulfate, with the results received from the laboratory 14 days later. Other parameters (e.g. Record of Decision metals and volatiles) are collected and analyzed in GWTP effluent samples according to the frequencies listed in Table 2-1 of the SAP.

As shown in Figure 1, groundwater is continuously extracted, treated, and discharged. If Harrison Bayou is flowing and indicator parameters are within their historical optimal ranges, then the ion exchange vessels can be bypassed and the GWTP effluent sample will be collected after the FBR. If Harrison Bayou is not flowing or the indicator parameters are not within historical optimal ranges, then the ion exchange vessels will be put on line, and the GWTP effluent sample will be collected between the lead and lag ion exchange vessel. Professional judgement may also be used as to when to bring the ion exchange vessels online, such as after a power outage or during anticipated cold temperatures when the FBR has historically not performed optimally.

If a parameter is measured in the effluent at a concentration above the discharge criteria, then a confirmation sample and an effluent sample after the lag ion exchange vessel will be collected and analyzed for the parameter with a 24-hour turnaround time. Corrective measures (e.g. increased nutrient or electron donor addition rates, bring ion exchange vessels on line) will be implemented as appropriate to bring the parameter back within the discharge criteria. ***If an upset condition in the FBR leads to high concentrations of perchlorate going into the lead ion exchange vessel and breaking through at the sample location between the vessels, the lag vessel will still remove perchlorate before it is discharged to Harrison Bayou, the INF Pond, or LHAAP-18/24.*** It is estimated that the lag ion exchange vessel can remove all of the perchlorate from two weeks of typical groundwater extraction at a concentration of 920 μg/L. If the residual perchlorate concentration after the FBR and lead ion exchange vessel is only 600 μg/L, the lag ion exchange vessel could last almost 2.5 years before perchlorate would be detected in the discharged effluent.

If a parameter exceeds the discharge criteria by more than 40% (see Appendix A-2, SAP, Section 7c of Monitoring and Reporting Requirements) or reaches 920 μg/L of perchlorate, then the GWTP will be put into full recycle mode (no discharge) until the parameter is below the discharge criteria again. Appendix A-2 of the SAP requires GWTP data to be provided to TCEQ monthly including a list of noncompliance(s), if applicable.

Discharge to Harrison Bayou

As shown in Figure 1, the GWTP effluent will be discharged to Harrison Bayou as long as it has a measurable flow. The flowrate in Harrison Bayou is estimated by measuring the height of water with a staff gauge and velocity in feet/sec at intervals along the width as described in the Installation-Wide Work Plan, Standard Operating Procedures, Attachment 18 – Water Depth and Velocity Measurements (AECOM, July 2014).

The allowable flow rate of GWTP effluent that can be discharged to Harrison Bayou is given by:

$$QE \leq \frac{QS\ (CC - CA)}{(CE - CC)}$$

where Q_E = GWTP effluent flow Q_S = Harrison Bayou flow

C_C = Criteria concentration (100 mg/L for chloride, 50 mg/L for sulfate)

C_A = Ambient concentration = 10 mg/L

C_E = Chloride or sulfate concentration in GWTP effluent

The allowable GWTP effluent flow will be the lower of the calculated values given the measured concentrations of chloride and sulfate in the discharge stream. For each day that GWTP effluent is discharged to Harrison Bayou, the measured Harrison Bayou flow, the allowable effluent flow, and the actual effluent flow are recorded.

Discharge to INF Pond

If Harrison Bayou is not flowing, then GWTP effluent will be discharged to the Intermediate-Range Nuclear Forces (INF) Pond for temporary storage until Harrison Bayou flow resumes. Perchlorate concentration detected in the effluent must be 17 µg/L or less, when this occurs.

The INF Pond has a flexible membrane liner protected by a soil cover with a gravity discharge pipe (and valve) to Harrison Bayou. The INF Pond has a nominal capacity of 3 million gallons with a staff gage to measure the height of water stored in the pond. The GWTP operator maintains the INF Pond by visually inspecting for erosion, vegetative growth including tree growth along the anchor trench, and liner integrity and making necessary repairs. Periodically, accumulated debris must be removed from the influent and effluent piping to the INF Pond.

Prior to discharging to the INF Pond, a lead and lag ion exchange vessel will be brought online. The GWTP Operator will also confirm that the discharge valve is closed, will record the reading on the effluent totalizer, and will record the height of water using the staff gage. The GWTP Operator will then configure valves and pumps to direct GWTP effluent to the INF Pond. The height of water in the INF Pond and totalizer reading will be recorded at the beginning and end of each shift for the duration of active discharge. When the height of water in the pond reaches 3 feet below the height of the berm (freeboard), the GWTP Operator will stop discharging to the INF Pond and TCEQ will be notified. After the TCEQ acknowledges the INF Pond level, GWTP effluent may be discharged to the INF Pond again until 2 feet of freeboard is reached. The GWTP Operator will stop discharging to the INF Pond and TCEQ will be notified again. After the TCEQ acknowledges 2 feet of freeboard in the INF Pond,GWTP effluent may be discharged again until 1 foot of freeboard remains. No additional GWTP effluent can be accepted at the INF Pond until greater than 1 foot of freeboard is measured.

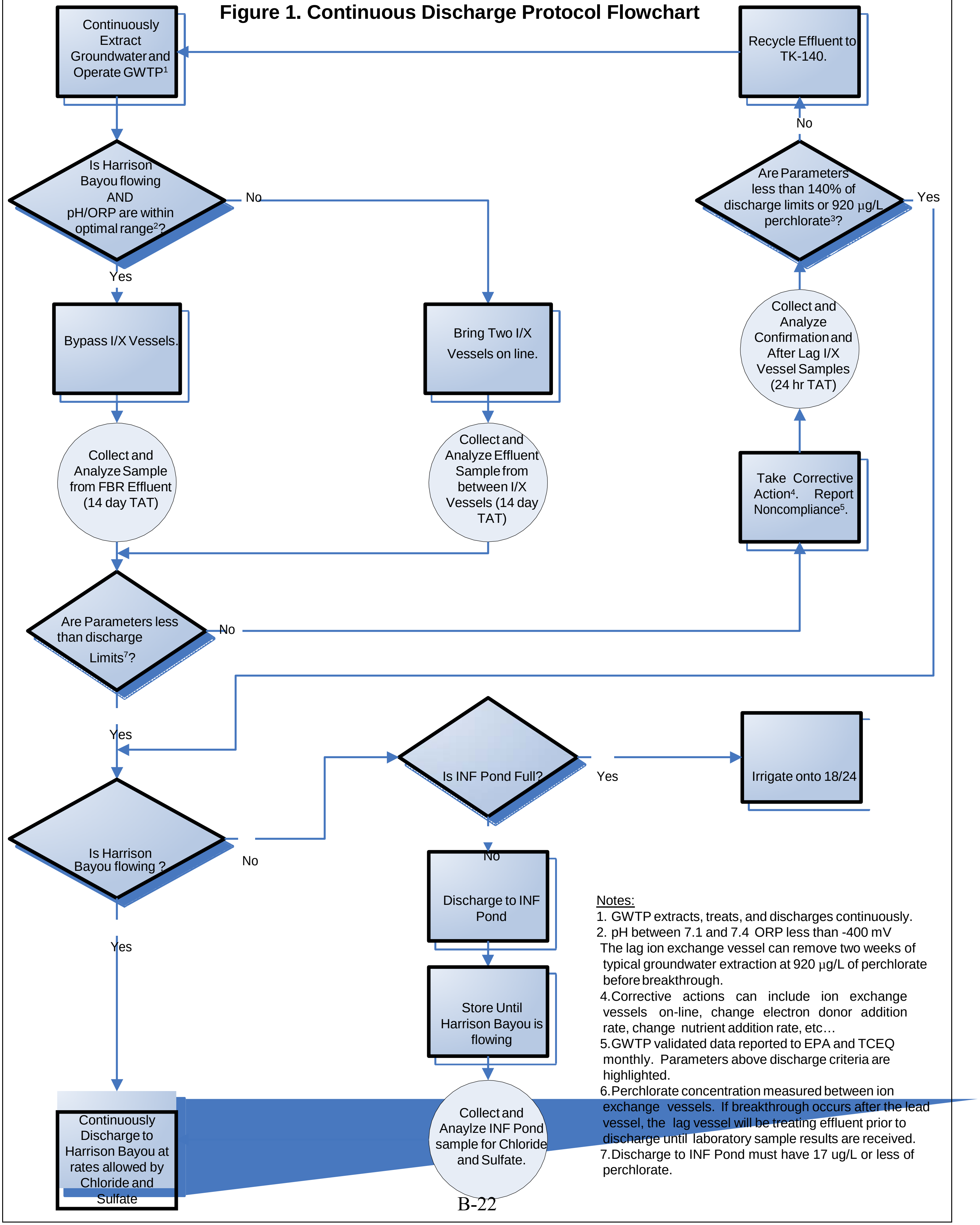
As soon as flow in Harrison Bayou returns, stored GWTP effluent from the INF Pond will be discharged. As with direct discharges from the GWTP to Harrison Bayou, the allowable flowrate of effluent from the INF Pond is calculated based upon the chloride and sulfate concentrations in the pond and the flow in Harrison Bayou. If effluent from the INF Pond and the GWTP are discharged simultaneously, total flow of both streams together should not exceed the calculated discharge level for either discharge location. For each day that INF Pond contents are discharged to Harrison Bayou, the measured Harrison Bayou flow, the allowable effluent flow, and the actual effluent flow are recorded.

Irrigation onto LHAAP-18/24

If Harrison Bayou is not flowing and the INF Pond has less than 1 foot of freeboard, then GWTP effluent will be irrigated onto LHAAP-18/24 using one of the three main sprinkler lines. To avoid pooling and runoff of irrigation water, only one line will be used for half a day at a time, with a separate line being used the second half of the day. If needed, the irrigation will occur 5 days a week for 8 hours each day (using 3 sprinklers in each line). If conditions are wet due to rain events, irrigation will not be conducted to avoid ponding and potential runoff, the GWTP will be put into recycle mode, and groundwater extraction will be interrupted if storage space is not available.

While irrigating, site inspections will be performed to ensure pooling and runoff are not occurring. During the irrigation activities, inspections will be performed twice a day, once approximately three hours and again approximately six hours into the 8-hour irrigation shift. The system will be inspected to ensure that the sprinkler heads are operating properly and not leaking large amounts of water. If ponding or runoff is observed, irrigation at that sprinkler line will cease, and irrigation at another sprinkler line will be started if possible. Volumes of GWTP effluent and twice daily inspections will be recorded daily and reported monthly until flow resumes in Harrison Bayou or greater than 1 foot of freeboard is available in the INF Pond.

Figure 1. Continuous Discharge Protocol Flowchart



Notes:

1. GWTP extracts, treats, and discharges continuously.
2. pH between 7.1 and 7.4 ORP less than -400 mV

The lag ion exchange vessel can remove two weeks of typical groundwater extraction at 920 µg/L of perchlorate before breakthrough.

4. Corrective actions can include ion exchange vessels on-line, change electron donor addition rate, change nutrient addition rate, etc…
5. GWTP validated data reported to EPA and TCEQ monthly. Parameters above discharge criteria are highlighted.
6. Perchlorate concentration measured between ion exchange vessels. If breakthrough occurs after the lead vessel, the lag vessel will be treating effluent prior to discharge until laboratory sample results are received.
7. Discharge to INF Pond must have 17 ug/L or less of perchlorate.

APPENDIX C

EXPLOSIVES MANAGEMENT PLAN

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EXPLOSIVES MANAGEMENT PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

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Table of Contents

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List of Acronyms and Abbreviations

AENRB	Arson and Explosives National Repository Branch
APP	Accident Prevention Plan
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
CFR	Code of Federal Regulations
DD	Department of Defense
DoD	United States Department of Defense
DOT	United States Department of Transportation
EMP	Explosives Management Plan
EZ	exclusion zone
ft	feet
IAW	in accordance with
LHAAP	Longhorn Army Ammunition Plant
MEC	Munitions and Explosives of Concern
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC-TLI Solutions Joint Venture
MPPEH	material potentially presenting an explosive hazard
MR	Munitions Response
PM	Project Manager
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TLI	TLI Solutions

USACE	United States Army Corps of Engineers
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

SIGNATURE PAGE

Explosives Management Plan for
TIME CRITICAL REMOVAL ACTION FOR MEC

LHAAP-17, Longhorn Army Ammunition Plant, Texas

Prepared By:		11/30/20
	Brian Gentry, Munitions Response Operations Manager MMG-TLI JV	Date (865) 206-6290

Approved By:	Kyra Donnell	11/30/20
	Kyra Donnell, Project Manager MMG-TLI JV	Date (865) 607-0502

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1. OBJECTIVE

This Explosives Management Plan (EMP) describes the minimum procedures to be followed during receipt and use of donor explosives during the conduct of a Time Critical Removal Action for Munitions and Explosives of Concern (MEC) at LHAAP-17 Burning Ground No.2/Flashing Area Group 2 (hereinafter LHAAP-17), Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas.

This EMP applies to all site personnel, including contractor and subcontractor personnel, involved in the conduct of explosives management on the site. This EMP is not intended to contain all of the requirements needed to ensure complete compliance and should be used in conjunction with project plans and applicable Federal, State, and local regulations. Consult the documents listed in the reference section of this EMP for additional compliance issues.

This EMP addresses the explosives management procedures to support munitions response fieldwork involving delivery of donor explosives by a state-licensed vendor for day use.

2. SIGNATURE SHEET

The signature page is included on page C-v of this document.

3. BACKGROUND INFORMATION

3.a Contractor

The contractor is Munitions Management Group, LLC (MMG)-TLI Solutions (TLI) Joint Venture (MMG-TLI JV) for the United States Army Corps of Engineers (USACE), Tulsa District.

3.b Contract Number

The contract number is W9128F18D0001, and the task order number is W912BV20F0207.

3.c Project Name

The project name is Time Critical Removal Action for MEC LHAAP-17, Karnack, Texas.

3.d Project Description

MMG-TLI JV has been contracted by USACE Tulsa District to perform munitions response to support the Remedy in Place for LHAAP-17. Under this TO, MMG-TLI JV is responsible for executing MEC field activities required to comply with the selected remedy under the existing ROD for LHAAP-17.

3.e Location of the Project

LHAAP is a former government-owned, contractor-operated and maintained Department of Defense (DoD) facility located in central-east Texas in the northeastern corner of Harrison County. The footprint of the former U.S. Army installation occupies 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake. The nearest cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the southeast. Caddo Lake, a large freshwater lake situated on the Texas-Louisiana border, bounds LHAAP to the north and east.

4. EQUIPMENT AND MATERIALS

- Fire extinguishers
- Explosive placards
- Vehicle wheel chalks
- Tie down straps
- Explosive day box(es)

5. PROCEDURE

5.a General

Safety is paramount for explosive operations. The most obvious requirements are to protect personnel, the public, and the environment from fire, blast, noise, fragmentation, and toxic releases. Proper inspection, handling, packaging, and inventory control are all tasks that must be considered to conduct a safe and efficient operation.

The procedures detailed in this EMP have been developed to ensure safe and efficient MEC and demolition material management is conducted. Absence of a written safety requirement does not indicate that safeguards are not required. Each individual authorized to receive, issue, transport, and use explosives will be identified by name and assume accountability when signing receipt or transfer documents. All transactions relating to explosive material acquisition and expenditures of explosive materials will be maintained for a period of five years. Records will be maintained at the project site during on-site operations and moved to the TLI corporate office at the conclusion of the field effort.

5.b Licenses and Permits

MMG-TLI JV will maintain on-site a copy of its Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) Type 33, User of Explosives License, No. 1-VA-059-33-3D-00982, expiration date 1 April 2023.

5.c Acquisition of Explosives

MMG-TLI JV will acquire the needed explosive materials from Buckley Powder.

The Senior Unexploded Ordnance Supervisor (SUXOS) will be responsible for initiating requisitions for demolition materials. The acquisition process will be accomplished by submitting a purchase order request through the MMG-TLI JV Munitions Response (MR) Operations Manager, who reviews and approves the request before forwarding it to the accounting department. The requisition of explosives will be in accordance with (IAW) the MMG-TLI JV purchasing policy to ensure the best possible price for acquiring the explosive materials.

The explosives distributor will be provided a certified statement of the intended use of the explosive material. The explosives vendor will be licensed by the ATF and the State of Louisiana to sell and transport explosives and will be capable of re-supply within a 24-hour period.

The quantity of donor explosives will be determined on an as-needed basis. The proposed donor explosives include:

- Jet Perforators
- Boosters
- Detonation Cord
- Electric Blasting Caps

5.d Receipt

Each individual authorized to receive, issue, transport, and use explosives will be identified by name and assume accountability when signing receipt of transfer documents. MMG-TLI JV will provide written authorization designating individuals authorized to purchase or use explosives. A copy of the letter will be maintained in the project office and will reflect:

- Name of individual
- Home address
- Date and place of birth
- Social Security number

Only those individuals named on the authorization list may sign for explosives from the shipper. In order to ensure that the quantity shipped is the same as the quantity listed on the shipping documents, the SUXOS and the Unexploded Ordnance Quality Control Specialist (UXOQCS) will inventory the shipment prior to signing the receipt.

The SUXOS and the vendor will reconcile any discrepancies in the quantities requisitioned, shown on the shipping documents, or received prior to TLI accepting the delivery.

5.e Storage

Commercial explosives will not be stored onsite. The commercial vendor will deliver the requested amount and type of explosives needed. The delivery will be made the same day of demolition operations. Material potentially presenting an explosive hazard (MPPEH) items that have been determined by the SUXOS and the Unexploded Ordnance Safety Officer (UXOSO) as safe to move may be stored onsite and will be done so in an ATF approved Type II magazine at a sited location.

5.f Transportation

5.f.i Procedures for Transportation to Disposal Site

Prior to transporting explosives, the vehicle operator will be informed of the explosive hazards involved with the cargo. Prior to movement, the operator will check cargo to ensure containers are loaded, blocked, braced, tied down, or otherwise secured to the vehicle body to prevent movement. Explosive material will not be transported in conjunction with incompatible material such as oils, matches, firearms, fuels, oxidizers, etc.

If Class 1.1, 1.2, or 1.3 explosives are being transported, appropriate explosives warning placards will be affixed to the vehicle on all four sides so that they are visible to responding emergency personnel in compliance with United States Department of Transportation (DOT) requirements. Placards are not required when transporting less than 1,001 pounds of Class 1.4 explosives IAW 49 Code of Federal Regulations (CFR), Part 172.504(c).

At all times, explosives-laden vehicles will be attended by a driver or other employee who has been made aware of the hazards and procedures in place to protect the public. Drivers of explosives-laden vehicles will come to a complete stop at railroad crossings and main highway intersections and will not proceed until the way is clear. If the vehicle has to be parked due to a change of schedule, the vehicle may be left unattended if parked in a securely fenced or walled area with all gates or entrances locked if the area is approved for explosives handling or storage.

A BATFE Type 3 magazine, or “Day Box,” will be used to transport explosives from the storage facility to the location of the demolition operation. TLI will provide a portable Day Box secured to a dedicated explosives transport vehicle to temporarily store explosives during site operations. The Day Box will be theft, fire, and weather-resistant and will consist of an interior and exterior that is constructed IAW ATF Type 3 magazine specifications.

5.f.ii Requirements for Vehicles Transporting Explosives

5.f.ii.1 Transport Vehicle Preparation

Transportation vehicles will be designated and inspected to determine that they are suitable and properly equipped for movement of explosive materials. Inspections will be recorded on a Motor Vehicle Inspection checklist (Department of Defense [DD] Form 626).

Vehicles designated to transport explosives must meet the following minimum inspection requirements:

- The exhaust system must be maintained in good mechanical condition and not be exposed to accumulations of oil, grease, or gasoline with ample clearance provided from fuel lines and other combustible materials;
- The vehicle electrical system must be working, in good repair, and properly attached to prevent short circuits;
- Brakes must be properly adjusted;
- Lights, steering, windshield wipers, and other mechanical systems must be working and in good condition;
- Tires must be property inflated and free of apparent defects; and,
- The fuel tank must be at least half full and not leaking, and all piping and fuel lines must be secure.

Vehicles transporting explosives will be placarded with the appropriate symbols/signs (Explosives 1.1, 1.2, or 1.3, as applicable) to provide a general warning to all personnel along the transportation route and to furnish specific guidance to firefighting personnel and other emergency response personnel that would normally respond to an emergency involving the vehicle.

Vehicles not having an enclosed bed will be covered with a flameproof and moisture-proof tarpaulin or other effective covering to protect the cargo from moisture and sparks.

Vehicles used for explosives transportation will have tight floors with all exposed, spark-producing metal inside the cargo compartment covered with wood or other non-sparking materials.

Explosives transport vehicles will be equipped with a minimum of one fire extinguisher rated of at least 10-B-C, properly filled, and located near the driver's seat with unobstructed access provided.

5.f.ii.2 Communication System

Telephone or radio communication will be established using two independent systems (i.e., cell phone and radio) between MMG-TLI JV personnel, the installation Commander or representative, and the installation emergency response personnel.

During movement of explosives-laden vehicles, radio contact will be maintained between the vehicle operator, Demolition Team Leader, UXOSO, and SUXOS.

5.f.ii.3 Safety

The following general safety precautions will be observed during transport operations:

- Blasting caps and high explosives will be separated at all times by either transporting the items in separate vehicles or, if transporting in the same vehicle, using a container specifically designed for transporting blasting caps (i.e., IME22 or MK663);
- Explosives will not be transported in the passenger compartment of a vehicle;
- Explosives will not be loaded above the sides of an open-body vehicle;

- No person is permitted to ride on or in the cargo compartment;
- Smoking or carrying matches/flame-producing devices is prohibited in and around vehicles transporting explosives;
- Vehicles will be refueled only when there is no explosive cargo;
- Vehicles will not exceed the posted speed limit. If a prudent speed is less than the posted speed limit, the operator may not exceed a safe and reasonable speed; and,
- The safest possible primary and alternate explosives movement routes will be designated, avoiding built-up areas and key, mission-oriented facilities and equipment to the maximum extent possible.

5.g Certification of Use

An MEC Accountability Log will be filled out completely for every demolition operation by the SUXOS, who will certify that the explosives were expended as intended in the MEC disposal process or returned to the vendor. The SUXOS will retain the original, as well as copies of the Bill of Lading and shipping documents, in the project files.

5.h Inventory

Commercial explosives will not be stored on-site and will be used on the day of delivery. If it is determined that on-site storage is necessary, a prior-approved project/site-specific work plan must address this activity.

A letter authorizing the use of commercial explosives will be maintained on-site and in the project file.

MPPEH discovered and determined safe to move/store will be stored in a sited ATF-approved Type 2, Class ABC magazine onsite, max Net Explosive Weight is 10lbs. All MEC/MPPEH items will be accounted for on a MEC/MPPEH Accountability Log. This log will be maintained on-site and controlled by the SUXOS.

5.i Inspection of Magazines

The MPPEH magazine items will be accounted for on a MEC/MPPEH accountability Log that is maintained by the SUXOS. Additionally, the MEC/MPPEH Accountability Log will be periodically inspected by the on-site UXOQCS.

5.j Reporting Loss or Theft of Explosive Materials

Discovery of lost or stolen explosive materials will be reported to local authorities, the SUXOS, and the MMG-TLI JV Project Manager (PM) immediately. The PM will immediately notify the USACE PM by phone and follow up by written communication within 24 hours. The following information, as a minimum, will be provided:

- Name and job classification of individual making initial report;
- Date incident was discovered;
- Nomenclature of material involved;
- Quantity of material involved; and,
- Date of previous inventory and name of individual(s) conducting the inventory.

The ATF will be notified within 24 hours when any theft or loss of explosive material is discovered. The following procedures will be followed by the MMG-TLI JV PM:

- Contact the ATF by phone at (469) 227-4300 (Dallas Field Division) between 8:00 AM–5:00 PM or (888) 283-2662 after hours and on the weekends to report the loss or theft.
- Contact the local law enforcement office to report the theft or loss and to obtain a police report.
- Complete ATF Form 5400.5 and attach any additional reports, sheets, or invoices necessary to provide the required information and fax or mail the form with the additional material(s) to:

  Bureau of Alcohol, Tobacco, Firearms and Explosives

  Arson and Explosives National Repository Branch (AENRB)

  P.O. Box # 50980

  Washington DC 20077-8001

  Toll Free Fax: (866)-927-4570

  Questions regarding the completion of the form should be referred to the AENRB toll-free number at: (800) 461-8841.

5.k Procedures for Return to Storage of Explosives Not Expended

All unexpended explosives will be expended onsite the day of delivery at the end of each demolition operation or returned to the vendor, who will stand by onsite.

5.l Procedures for Disposal of Remaining Explosives

All unexpended explosives will be disposed of by detonation onsite prior to project demobilization.

5.m Economic Analysis of Different Alternatives for Explosives Management

Due to the small quantities of explosives expected to be required at this site, just-in-time delivery is a more cost-effective solution than long-term explosives storage.

6. ADDITIONAL INFORMATION

6.a Health and Safety Considerations

An Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) must be approved and available prior to implementation of this EMP in the field. All field personnel must review the APP/SSHP prior to beginning work.

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

6.b Fire Protection

Personnel must be alert to fire hazards, ensure good housekeeping practices, and ensure fire safety rules prevail throughout explosive operations.

6.c Fire Prevention Requirements

The following guidance is provided to enhance fire prevention within explosives storage/handling and operating locations:

- No smoking, open flame, or fire of any kind within 50 feet (ft) of any area where explosive materials are located;
- Flammable liquids shall not be used for cleaning in areas where explosive materials are present during operations; and,
- Vehicles will be turned off while loading and unloading explosive materials.

6.d Fire Extinguishers

Portable hand-held fire extinguishers within operational areas and on transport vehicles can extinguish fires before major damage is done. The following minimum requirements shall be met:

- A minimum of two fully charged 10-B-C fire extinguishers shall be present during explosives demolition operations within the demolition operations area (one or more may be located on a vehicle used during the operation).
- The extinguishers need not be permanently located at the site. Each extinguisher will be placed in a conspicuous and readily accessible location

6.e Communications

Site operations will not be conducted unless on-site communications are available. On-site communications may be accomplished either using field radios and/or cell phone service. If cell phone service is not available, all site personnel must be aware of the location of the closest telephone or have direct radio communications to someone with telephone service available. If used, radios capable of communicating with the project field office or site safety representative will be located in each vehicle or taken with teams on foot.

The Fire Department will be notified in advance of any planned demolition operation.

Visual and/or radio communication between personnel in the support zone and personnel in the exclusion zone (EZ) will be maintained at all times.

The horns of vehicles or air horns, which are provided in each vehicle and EZ, will be used as a backup emergency notification system. The following horn signals will be used to communicate with personnel if the radio is not operable:

- One long blast: “Evacuate the Area”
- Two short blasts: “All Clear”
- Three short blasts: “Emergency Help Required”

The location of assembly points, emergency evacuation points, emergency routes, and other contents of the APP/SSHP will be discussed as necessary during the tailgate safety meetings. Copies of the APP/SSHP will be maintained in the field office, if applicable, and site vehicles.

7. REFERENCES

Bureau of Alcohol, Tobacco, and Firearms 5400.7, *Federal Explosives Laws and Regulations*, April 2012.

Department of Army Pamphlet 385-64, *Ammunition and Explosives Safety Standards*, October 2013.

United States Department of Defense 4145.26-M, *Contractor's Safety Manual for Ammunition and Explosives,* March 2008.

United States Department of Defense 6055.09-M, *Department of Defense Ammunition and Explosives Safety Standards,* Change 2, December 15, 2017.

United States Army Corps of Engineers, Engineering Manual 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2015.

United States Army Corps of Engineers, Engineering Manual 385-1-1, *Safety and Health Requirements*, November 2014.

United States Army Corps of Engineers, Engineering Manual 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

APPENDIX D

WASTE MANAGEMENT PLAN

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WASTE MANAGEMENT PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers,
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

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Table of Contents

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List of Acronyms and Abbreviations

APP-SSHP	Accident Prevention Plan-Site Safety and Health Plan
BIP	blown-in-place
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DDESB	Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DOT	United States Department of Transportation
EMP	Explosives Management Plan
EPA	United States Environmental Protection Agency
ERS	Environmental Remediation Services
ESS	Explosives Safety Submission
ft	feet
IAW	in accordance with
ID	identification number
IRP	Installation Restoration Program
LHAAP	Longhorn Army Ammunition Plant
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC-TLI Solutions Joint Venture
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard

NMRD	non-munitions related debris
OERR	Office of Emergency and Remedial Response
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCL	Residual Contaminant Level
RDW	remediation-derived waste
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
SOP	Standard Operating Procedure
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Unit
TAL	Total Analytical List
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxic Characteristics Leaching Procedure
TLI	TLI Solutions
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
UN	United Nations
USC	United States Code
UXO	unexploded ordnance
VOC	volatile organic compound
WMP	Waste Management Plan

1. INTRODUCTION

This Waste Management Plan (WMP) describes the waste management requirements and procedures to be followed during the completion of a Time Critical Removal Action (TCRA) for Munitions and Explosives of Concern (MEC) at LHAAP-17 Burning Ground No.2/Flashing Area Group 2 (hereinafter LHAAP-17), Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. The objective of the TCRA is to significantly reduce, mitigate or eliminate the potential of an encounter with MEC to the public (i.e. off-path Caddo Lake National Wildlife Refuge visitors and trespassers) and environmental construction workers carrying out the requirements of the LHAAP-17 Record of Decision (ROD) (Shaw, 2016).

This WMP applies to all site personnel, including contractor and subcontractor personnel, involved in the conduct of munitions response activities and related waste generation activities on the site.

2. WASTE STREAMS

Office waste such as paper, paper towels, lunch waste, etc. will be collected in black or non-translucent garbage bags and disposed of in a designated receptacle at the project field office. Restrooms/portable toilets will be serviced once per week during field activities, and all waste will be hauled off-site by the service contractor. Remediation-derived waste (RDW) streams anticipated to be generated and managed are identified in Table 1.

Note that the United States Environmental Protection Agency (EPA) guidance (EPA, 1991) does not recommend removal of wastes from all sites and, in particular, from those sites where RDW do not pose any immediate threat to human health or the environment.

3. WASTE SAMPLING AND ANALYSES

Samples for waste characterization will be collected in accordance with (IAW) Appendix F of the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), Standard Operating Procedure (SOP) Number 13-02, Waste Sampling and Analysis Procedures—Drum or Container Sampling and Analysis Procedure, Current Version and analyzed as shown in Table 1 and the approved UFP-QAPP.

4. WASTE CLASSIFICATION AND PROFILING

Wastes will first be screened according to the criteria identified in Table 1. Wastes (other than solid waste placed in dumpsters) destined for off-site disposal will be profiled based on waste characterization analytical results.

Existing waste profiles will be used as available. Otherwise, waste profiles, as required by the disposal facility, will be completed by the Munitions Management Group, LLC (MMG)-TLI Solutions (TLI) Joint Venture (MMG-TLI JV) for all waste that will be treated/disposed of off-site. Waste characterization information will be documented and used to complete the waste profile form(s) provided by the disposal facility as part of the waste acceptance process. The profile and any associated documents, such as waste manifests, will be signed by the Army Base Realignment and Closure (BRAC) representative as the generator. Signed profile(s) will be submitted to the appropriate off-site facility for acceptance.

The profile typically requires information including, but not limited to, the following:

- Generator information, including name, address, contact phone number, and EPA identification number (ID)
- Site name, including street and mailing address
- Process that generated the waste (for example, decontamination of equipment)
- Source of contamination and historical use (that is, historical fill activities)
- Waste composition (for example, 95% soil, 5% debris)

- Physical state of waste (for example, solid, liquid, etc.)
- Resource Conservation and Recovery Act (RCRA) hazardous waste codes (if applicable)

A copy of the approved waste profile or an approval letter from the disposal and treatment facility will be supplied to MMG-TLI JV before transporting the waste off site.

Table 1—Waste Streams, Source/Process, Characterization, Staging and Disposition

	Waste Stream	Source/Process	Characterization	Staged In/At	Disposition
1	Cut Vegetation	Grass, brush, or trees will be removed, as needed, to mitigate interference with digital geophysical mapping (DGM).	None.	Not Applicable.	Mowed/cut grasses will be left in place. Brush/trees will be removed to outside the DGM transects and left in place.

Table 1—Waste Streams, Source/Process, Characterization, Staging and Disposition

	Waste Stream	Source/Process	Characterization	Staged In/At	Disposition
2	Soils excavated during removal and inspection of individual, target anomalies	Soils will be excavated to access/investigate the source of the anomaly.	Soils will be screened via visual observation by unexploded ordnance (UXO)-qualified personnel. If the source of the anomaly is determined to be compromised, breached, low-order, or exposed MEC, and it is safe to move, a grab sample will be taken from beneath removed MEC and subject to laboratory analysis for explosives and perchlorate IAW the UFP-QAPP. See #6 in the event MEC/MDEH is blown-in-place (BIP).	Soils will be adjacent to excavation until quality control/quality assurance (QC/QA) check of the hole is complete. Soil managed as a potential hotspot will be stored in a United States Department of Transportation (DOT)-approved 55-gallon drum pending results at a LHAAP-designated, RCRA-compliant location to be determined.	If the source of the anomaly is not munitions related, soils will be placed back into the hole. If the source of the anomaly is determined to be MEC or other Material Potentially Presenting an Explosive Hazard (MPPEH), the MEC is not compromised, and there is no visible evidence of soil staining, soils will be placed back into the hole following sampling of soils beneath the removed MEC/MPPEH. If the source of the anomaly is determined to be compromised/ breached/ low-order MEC and there is visible evidence of soil staining, all visible explosives and potential explosive soil will be removed and managed as MEC (see #3). Soil within approximately 6 inches to 1 foot (ft) of removed material will be excavated as a potential hotspot, drummed, and managed IAW analytical results. Depending on screening of analytical results Cleanup levels presented in Table 1-2 and 1-3 of the RD/RAWP, LHAAP 17 (Bhate/APTIM, March 2019), soil will be removed for off-site disposal as contaminated soil at a Subtitle D landfill. Existing waste profiles for soil will be used where appropriate for complete characterization of soils for off-site disposal.

Table 1—Waste Streams, Source/Process, Characterization, Staging and Disposition (continued from previous page)

	Waste Stream	Source/Process	Characterization	Staged In/At	Disposition
3	MEC/Material Documented as an Explosive Hazard (MDEH)	MEC/MDEH will be potentially recovered during surface clearance or during the removal and inspection of target anomalies.	MEC/MDEH will be screened via visual observation by UXO-qualified personnel.	If safe to move, MEC/MDEH will be temporarily stored in a portable Type II magazine IAW UFP-QAPP Appendix B, Department of Defense Explosives Safety Board (DDESB)-approved Explosives Safety Submission (ESS) and UFP-QAPP Appendix E, Explosives Management Plan (EMP) and subsequent on-site detonation within LHAAP-17. If not safe to move, material will be BIP within LHAAP-17.	Material will be disposed of IAW the DDESB-approved ESS
4	Material Documented as Safe (MDAS)	MDAS will be potentially recovered during surface clearance or during the removal and inspection of target anomalies.	MDAS will be screened via visual inspection by UXO-qualified personnel and determined to be explosive free.	Material will be stored in a locked container (typically a 55-gallon drum) within the bounds of LHAAP 17 until the end of field activities.	Material will be disposed of via off-site recycling at a qualified recycling facility.
5	Non-munitions related debris (NMRD)	Material will be potentially recovered during surface clearance or during	Material will be screened via visual inspection by UXO-qualified personnel and	Material will be stored in a locked container (typically a 55-gallon drum or roll-off) within	Material will be disposed of via off-site recycling at a local scrap metal vendor.

Table 1—Waste Streams, Source/Process, Characterization, Staging and Disposition (continued from previous page)

	Waste Stream	Source/Process	Characterization	Staged In/At	Disposition
		the removal and inspection of target anomalies.	determined not to be munitions-related debris.	the bounds of LHAAP-17 until the end of field activities.	
6	Soils potentially impacted by detonation of MEC/MDEH	Sources are hot spots potentially generated as a result of BIP or consolidated shot detonation of recovered MEC/MDEH.	Material will be screened via laboratory analysis for explosives IAW the UFP-QAPP.	Material will be stored in a United States DOT-approved 55-gallon drum pending results at a LHAAP-designated, RCRA-compliant location to be determined.	Depending on screening of analytical results against the cleanup levels presented in Table 1-2 and 1-3 of the RD/RAWP, LHAAP 17 (Bhate/APTIM, March 2019), soil will be either left in place, or identified hot spots will be removed for off-site disposal as contaminated soil at a Subtitle D landfill.. Existing waste profiles for soil will be used where appropriate for complete characterization of soils for off-site disposal.
7	Any containerized solid or liquid waste potentially exhibiting a hazardous waste characteristic (e.g., decontamination water) or destined for off-site disposal to Subtitle D or C landfill	Material is potentially generated as a result of spill, on-site detonation of MEC, decontamination of sampling equipment, or other munitions response activities.	Material will be screened via laboratory analysis for explosives, TAL metals, Toxic Characteristics Leaching Procedure (TCLP), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs).	Material will be stored in a DOT-approved 55-gallon drum at a LHAAP-designated, RCRA-compliant location to be determined.	Material will be disposed of via off-site disposal at a location determined as a result of laboratory analyses (e.g., Subtitle D landfill for solid waste and Subtitle C landfill for hazardous waste).
8	Water within excavations in contact contaminated soil	Groundwater and/or rain water fills up the open excavations	Water will be tested by excavation area for VOCs (reporting trichloroethene, vinyl chloride, 1,1-Dichloroethene, 1,2-	Water will be stored in excavations or a frac tank until results of samples are received.	Water will be discharged to ground once verified to meet discharge criteria. If necessary, water will be treated prior discharge. Water can be discharged to ground if the cleanup levels for VOCs,

Table 1—Waste Streams, Source/Process, Characterization, Staging and Disposition (continued from previous page)

	Waste Stream	Source/Process	Characterization	Staged In/At	Disposition
			Dichloroethane, cis-1,2-Dichlorothylene), perchlorate, and explosives (reporting 2,4,6-Trinitrotoluene, 2,4-Dinitrotoluene, and 2,6-Dinitrotouene) IAW the current Installation-Wide Work Plan (Bhate, 2018).		perchlorate, and explosives presented in Table 1-2 of the RD/RAWP (Bhate/APTIM, March 2019) are met.
9	Miscellaneous trash including disposable personal protective equipment (PPE) and spent spoons/scoops/bowls used for soil sampling classified and managed as solid waste	Material is generated as a result of the munitions response fieldwork.	Material will be screened as it is generated.	Material will be collected in black, non-translucent trash bags and stored in a container with a lid.	Material will be removed to a local landfill or approved on-site trash receptacle.

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5. GENERAL WASTE MANAGEMENT REQUIREMENTS

The following practices will be implemented for drums and containers:

- Empty containers for waste collection (e.g., 55-gallon drums, roll-offs, or approved equivalent) will be inspected upon arrival at the project site for signs of disrepair and contamination or contents. If the containers are in disrepair, are contaminated, or already contain waste, they will be immediately rejected.
- Containers will be compatible with the waste placed in the container.
- Containers will be United Nations (UN)-rated and approved for specific waste.
- Each container will be provided with its own label, and labels will be visible.
- Waste streams will be segregated at the point of generation and during staging (e.g., hazardous wastes will be segregated from solid wastes). Wastes of the same matrix, contamination, and source may be aggregated to facilitate accumulation and disposal.
- Open head drum lids will be inspected to verify that the gasket is in good shape and that the lid will seat properly on the drum. Closed head drums will be inspected to verify that the bung will close properly.
- Containers will remain completely closed with all lids, covers, bolts, and locking mechanisms engaged, as though ready for immediate transport, except when removing or adding waste to the drum.
- Hazardous waste is not anticipated to be generated. If a waste stream is generated and deemed potentially hazardous based on user knowledge, containers will be closed and labeled and removed to a RCRA-compliant hazardous waste accumulation area designated by LHAAP pending analysis.
- All containers staged on-site (i.e., MDAS) will be inspected daily at the end of the duty day for proper labeling and to ensure these are secured. Any deficiencies observed or noted during inspection will be corrected immediately. Inspections will be recorded in the project log book.
- While on-site, waste containers will be labeled by MMG-TLI JV with the container contents. The labels will note the type of waste, the location from which the waste was generated, and the accumulation start date.
- MMG-TLI JV will arrange for transport and disposal of all waste containers destined for off-site disposal. The waste hauler/disposal facility will be approved by CMTS. The waste transportation subcontractor will provide waste labels to be used for off-site transportation.

6. TRANSPORTATION REQUIREMENTS FOR OFF-SITE DISPOSAL

MMG-TLI JV will arrange for off-site transport and disposal with licensed and permitted facilities approved by LHAAP. A transporter licensed and permitted for transportation of contaminated soil will be utilized for excavated soils that are not approved to be placed back in the excavation. In the event that wastes are hazardous, the transporter will also have a EPA ID and will comply with transportation requirements outlined in 49 Code of Federal Regulations (CFR) 171-180 (DOT), 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation).

End dumps used for off-site disposal will be equipped with appropriate liners and tarps in acceptable working condition, and all loads will be lined and covered prior to departure. Liners and covers will be properly secured to assure that the vehicles do not leak or release any waste constituents at any time during the transport process. Waste materials will be loaded in an area designated during mobilization.

Each transportation vehicle and load of waste will be inspected before leaving the site and documented.

Drivers of off-site disposal trucks must not come into physical contact with the contaminated material while covering the load or preparing it for transport. There will be no visible soil/waste material on the sides or tires of any trucks leaving the staging area or vehicle leaving the site. Proper decontamination procedures to remove soil or debris from the outsides of the vehicles will be employed if necessary to ensure soil is not tracked beyond designated work areas.

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container or dump truck. Disposal quantities will be based on the difference of weight measurements between the full and empty dump truck. Weights will be recorded on the waste manifest and weight ticket.

The transporter will observe the following practices when hauling and transporting wastes off-site:

- Minimize impacts to general public traffic;
- Repair road damage caused by construction and/or hauling traffic;
- Line and cover trucks/trailers used for hauling hazardous or regulated waste to prevent spills or releases;
- Decontaminate vehicles prior to re-use, other than hauling contaminated waste;
- Ensure seals on trucks transporting liquids are in good condition; and
- Wastes or materials from other sites may not be combined with wastes generated during this project.

All personnel involved in off-site disposal activities will follow safety and spill response procedures outlined in Appendix C of the UFP-QAPP, Accident Prevention Plan-Site Safety and Health Plan (APP-SSHP). All loads will be covered and the trucks inspected to ensure the loads are secure, proper placarding is provided as necessary, and shipping documentation is accurate.

7. DISPOSAL REQUIREMENTS

Consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Off-Site Rule, wastes generated from CMTS activities, such as contaminated soil or hazardous waste, at a CERCLA site may be transferred only to off-site facilities that have been deemed acceptable by the EPA Regional Off-Site Contact (40 CFR 300.400[b]). MMG-TLI JV will confirm the facility is approved to receive wastes under the CERCLA Off-Site Rule before transporting any wastes.

8. DOCUMENTATION

The following records and documents shall be maintained:

- A Tracking Log for all wastes and recyclables that are removed from LHAAP for disposition. The Tracking Log shall contains the following information at a minimum:
  - A specific ID corresponding to each container or stockpile generated at the site;
  - The date that waste (or recyclable material) was first placed in the container;
  - The staging location;
  - The profile number associated with any waste, as applicable;
  - The date that the container was transported for final disposal and the name of the transporter moving the container;

  - The means of disposal: off-site/bulk shipment/in containers. If containers are consolidated for bulk transport, that should be noted in the comments; and
  - Manifest number (off-site disposal of waste only).
- Transportation and off-site disposal records, including:
  - Profiles and associated characterization data, as applicable;
  - Copies of facility signed/executed manifests, as applicable; and
  - Designated off-site facility waste receipts, certificates of disposal/recycling (maintained by the Base).
- Inspection records

9. REFERENCES

Bhate, 2018. USACE-approved *Final Basewide Uniform Federal Policy-Quality Assurance Project Plan, Longhorn Army Ammunition Plant,* May.

Bhate/APTIM, 2019. Draft Final Remedial Design and Remedial Action Work Plan, LHAAP-17 Burning Ground No. 2/Flashing Area, Group 2 Longhorn Army Ammunition Plant, Karnack, Texas.

United States Environmental Protection Agency, 1991. EPA/540/G-91/009, Office of Emergency and Remedial Response (OERR) Directive 9345.3-02, *Management of Investigation-Derived Wastes During Site Inspections*, May.

42 United States Code (USC) 103, Comprehensive Environmental Response, Compensation, and Liability Act, 1980.

Title 40 Code of Federal Regulations, Parts 239 through 282, Resource Conservation and Recovery Act, 1976.

Title 49 Code of Federal Regulations, Transportation.

USACE, 2017. Remediation of Multiple Sites, Longhorn Army Ammunition Plant, Karnack, TX

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APPENDIX E
LABORATORY CERTIFICATIONS

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CERTIFICATE OF ACCREDITATION

ANSI National Accreditation Board

11617 Coldwater Road, Fort Wayne, IN 46845 USA

This is to certify that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

has been assessed by ANAB and meets the requirements of international standard

ISO/IEC 17025:2005

and the

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.1.1)

while demonstrating technical competence in the field of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of activities to which this accreditation applies

L2229
Certificate Number

ANAB Approval

Certificate Valid Through: 12/15/2021
Version No. 004 Issued: 07/11/2019

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND U.S. DEPARTMENT OF DEFENSE (DOD) QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.1.1)

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph. D., QA Officer
407-425-6700

TESTING

Valid to: **December 15, 2021**   Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanoic Acid

Drinking Water

Technology	Method	Analyte
LC/MS/MS	EPA 537.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	ADONA
LC/MS/MS	EPA 537.1	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	EPA 537.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	EPA 537.1	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol

Non-Potable Water

Technology	Method	Analyte
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	Total PCB
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethane

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624.1; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromobenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 624.1; EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 625.1; EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 625.1; EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D	Acetophenone
GC/MS	EPA 625.1; EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 625.1; EPA 8270D	Atrazine
GC/MS	EPA 625.1; EPA 8270D	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D	Benzidine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1; EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Carbazole
GC/MS	EPA 625.1; EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 625.1; EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobenzene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 625.1; EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 610	1-Methylnaphthalene
HPLC	EPA 610	2-Methylnaphthalene
HPLC	EPA 610	Acenaphthene
HPLC	EPA 610	Acenaphthylene
HPLC	EPA 610	Anthracene
HPLC	EPA 610	Benzo(a)anthracene
HPLC	EPA 610	Benzo(a)pyrene
HPLC	EPA 610	Benzo(b)fluoranthene
HPLC	EPA 610	Benzo(g h i)perylene
HPLC	EPA 610	Benzo(k)fluoranthene
HPLC	EPA 610	Chrysene
HPLC	EPA 610	Dibenz(a,h)anthracene
HPLC	EPA 610	Fluoranthene
HPLC	EPA 610	Fluorene
HPLC	EPA 610	Indeno(1,2,3-cd)pyrene
HPLC	EPA 610	Naphthalene
HPLC	EPA 610	Phenanthrene
HPLC	EPA 610	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)

Non-Potable Water

Technology	Method	Analyte
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamide

Non-Potable Water

Technology	Method	Analyte
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead

Non-Potable Water

Technology	Method	Analyte
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium

Non-Potable Water

Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide

Non-Potable Water		
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 610; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE

Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	EPA 8081B	4,4`-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP

Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	AK-103	Residual range organics (RRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 8260B/C	1,2-Dichloroethene (total)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C	n-Propylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene (total)
GC/MS	EPA 8260B/C	m,p-Xylene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl (1,1’-Biphenyl)
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 8270D	Pyridine

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene

Solid and Chemical Materials

Technology	Method	Analyte
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	6:2 Fluorotelomer Sulfonate

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	EPA 537 MOD²	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-1515	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium

Solid and Chemical Materials

Technology	Method	Analyte
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1010A MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229
2. Not compliant with QSM V5.1.1 Table B-15

Vice President

Jon Niermann, *Chairman*
Emily Lindley, *Commissioner*
Bobby Janecka, *Commissioner*
Toby Baker, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

May 20, 2021

Dr. Svetlana Izosimova
SGS North America Inc. – Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811-5803

Subject: Accreditation renewal

Dear Dr. Izosimova:

I am writing to congratulate you and the staff of *SGS North America Inc. – Orlando*. Based on your application and primary NELAP accreditation from the state of Florida, pursuant to authorization from the Executive Director of the Texas Commission on Environmental Quality, the Program Manager of the Quality Assurance Section has renewed your laboratory's secondary NELAP accreditation.

I am enclosing the new accreditation certificate and fields of accreditation listing. Please review the enclosures for accuracy and completeness. Your laboratory's accreditation is valid until the expiration date on the certificate and scope, contingent on continued compliance with the requirements of the state of Texas as well as those of your primary accreditation body.

Please contact me by electronic-mail at frank.jamison@tceq.texas.gov if I can provide any additional information or assistance.

Sincerely,

Frank Jamison
Data and Records Specialist

Enclosures

P.O. Box 13087 • Austin, Texas 78711-3087 • 512-239-1000 • tceq.texas.gov

How is our customer service?   tceq.texas.gov/customersurvey

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

SGS North America Inc. – Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811-5803

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: T104704404-21-15
Effective Date: 6/1/2021
Expiration Date: 5/31/2022

Executive Director Texas Commission on Environmental Quality

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704404-21-15
Expiration Date: 5/31/2022
Issue Date: 6/1/2021

SGS North America Inc. – Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811-5803

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Non-Potable Water***

Method EPA 1010

Analyte	**AB**	**Analyte ID**	**Method ID**
Ignitability	FL	1780	10116606

Method EPA 1020

Analyte	**AB**	**Analyte ID**	**Method ID**
Ignitability	FL	1780	10117007

Method EPA 120.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Conductivity	FL	1610	10006403

Method EPA 1664

Analyte	**AB**	**Analyte ID**	**Method ID**
n-Hexane Extractable Material (HEM) (O&G)	FL	1803	10127807

Method EPA 180.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Turbidity	FL	2055	10011606

Method EPA 200.7

Analyte	**AB**	**Analyte ID**	**Method ID**
Aluminum	FL	1000	10013806
Antimony	FL	1005	10013806
Arsenic	FL	1010	10013806
Barium	FL	1015	10013806
Beryllium	FL	1020	10013806
Cadmium	FL	1030	10013806
Calcium	FL	1035	10013806
Chromium	FL	1040	10013806
Cobalt	FL	1050	10013806
Copper	FL	1055	10013806
Iron	FL	1070	10013806
Lead	FL	1075	10013806
Magnesium	FL	1085	10013806
Manganese	FL	1090	10013806

Certificate:	**T104704404-21-15**
Expiration Date:	**5/31/2022**
Issue Date:	**6/1/2021**

SGS North America Inc. – Orlando

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Matrix: ***Non-Potable Water***

Molybdenum	FL	1100	10013806
Nickel	FL	1105	10013806
Potassium	FL	1125	10013806
Selenium	FL	1140	10013806
Silver	FL	1150	10013806
Sodium	FL	1155	10013806
Strontium	FL	1160	10013806
Thallium	FL	1165	10013806
Tin	FL	1175	10013806
Titanium	FL	1180	10013806
Vanadium	FL	1185	10013806
Zinc	FL	1190	10013806

Method EPA 200.8

Analyte	AB	Analyte ID	Method ID
Aluminum	FL	1000	10014605
Antimony	FL	1005	10014605
Arsenic	FL	1010	10014605
Barium	FL	1015	10014605
Beryllium	FL	1020	10014605
Cadmium	FL	1030	10014605
Calcium	FL	1035	10014605
Chromium	FL	1040	10014605
Cobalt	FL	1050	10014605
Copper	FL	1055	10014605
Iron	FL	1070	10014605
Lead	FL	1075	10014605
Magnesium	FL	1085	10014605
Manganese	FL	1090	10014605
Molybdenum	FL	1100	10014605
Nickel	FL	1105	10014605

Matrix: ***Non-Potable Water***

Potassium	FL	1125	10014605
Selenium	FL	1140	10014605
Silver	FL	1150	10014605
Sodium	FL	1155	10014605
Strontium	FL	1160	10014605
Thallium	FL	1165	10014605
Tin	FL	1175	10014605
Titanium	FL	1180	10014605
Vanadium	FL	1185	10014605
Zinc	FL	1190	10014605

Method EPA 245.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	FL	1095	10036609

Method EPA 300.0

Analyte	**AB**	**Analyte ID**	**Method ID**
Bromide	FL	1540	10053200
Chloride	FL	1575	10053200
Fluoride	FL	1730	10053200
Nitrate as N	FL	1810	10053200
Nitrate-nitrite	FL	1820	10053200
Nitrite as N	FL	1840	10053200
Orthophosphate as P	FL	1870	10053200
Sulfate	FL	2000	10053200

Method EPA 335.4

Analyte	**AB**	**Analyte ID**	**Method ID**
Total cyanide	FL	1645	10061402

Method EPA 350.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Ammonia as N	FL	1515	10063408

Method EPA 351.2

Analyte	**AB**	**Analyte ID**	**Method ID**

Certificate: T104704404-21-15

SGS North America Inc. – Orlando

Expiration Date: 5/31/2022

4405 Vineland Road, Suite C-15
Orlando, FL 32811-5803

Issue Date: 6/1/2021

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Non-Potable Water***

Kjeldahl Nitrogen (Total Kjeldahl Nitrogen-TKN)	FL	1790	10065404

Method EPA 353.2

Analyte	AB	Analyte ID	Method ID
Nitrate as N	FL	1810	10067400
Nitrate-nitrite	FL	1820	10067400
Nitrite as N	FL	1840	10067400

Method EPA 365.1

Analyte	AB	Analyte ID	Method ID
Orthophosphate as P	FL	1870	10070005
Phosphorus	FL	1910	10070005

Method EPA 365.3

Analyte	AB	Analyte ID	Method ID
Orthophosphate as P	FL	1870	10070801
Phosphorus	FL	1910	10070801

Method EPA 420.4

Analyte	AB	Analyte ID	Method ID
Total phenolics	FL	1905	10080203

Method EPA 6010

Analyte	AB	Analyte ID	Method ID
Aluminum	FL	1000	10155201
Antimony	FL	1005	10155201
Arsenic	FL	1010	10155201
Barium	FL	1015	10155201
Beryllium	FL	1020	10155201
Cadmium	FL	1030	10155201
Calcium	FL	1035	10155201
Chromium	FL	1040	10155201
Cobalt	FL	1050	10155201
Copper	FL	1055	10155201
Iron	FL	1070	10155201
Lead	FL	1075	10155201

Certificate: **T104704404-21-15**

SGS North America Inc. – Orlando

Expiration Date: **5/31/2022**

4405 Vineland Road, Suite C-15
Orlando, FL 32811-5803

Issue Date: **6/1/2021**

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Non-Potable Water***

Magnesium	FL	1085	10155201
Manganese	FL	1090	10155201
Molybdenum	FL	1100	10155201
Nickel	FL	1105	10155201
Potassium	FL	1125	10155201
Selenium	FL	1140	10155201
Silver	FL	1150	10155201
Sodium	FL	1155	10155201
Strontium	FL	1160	10155201
Thallium	FL	1165	10155201
Tin	FL	1175	10155201
Titanium	FL	1180	10155201
Vanadium	FL	1185	10155201
Zinc	FL	1190	10155201

Method EPA 6020

Analyte	**AB**	**Analyte ID**	**Method ID**
Aluminum	FL	1000	10156419
Antimony	FL	1005	10156419
Arsenic	FL	1010	10156419
Barium	FL	1015	10156419
Beryllium	FL	1020	10156419
Cadmium	FL	1030	10156419
Calcium	FL	1035	10156419
Chromium	FL	1040	10156419
Cobalt	FL	1050	10156419
Copper	FL	1055	10156419
Iron	FL	1070	10156419
Lead	FL	1075	10156419
Magnesium	FL	1085	10156419
Manganese	FL	1090	10156419

Matrix: ***Non-Potable Water***

Molybdenum	FL	1100	10156419
Nickel	FL	1105	10156419
Potassium	FL	1125	10156419
Selenium	FL	1140	10156419
Silver	FL	1150	10156419
Sodium	FL	1155	10156419
Strontium	FL	1160	10156419
Thallium	FL	1165	10156419
Tin	FL	1175	10156419
Titanium	FL	1180	10156419
Vanadium	FL	1185	10156419
Zinc	FL	1190	10156419

Method EPA 608.3

Analyte	AB	Analyte ID	Method ID
4,4'-DDD	FL	7355	10296625
4,4'-DDE	FL	7360	10296625
4,4'-DDT	FL	7365	10296625
Aldrin	FL	7025	10296625
alpha-BHC (alpha-Hexachlorocyclohexane)	FL	7110	10296625
Aroclor-1016 (PCB-1016)	FL	8880	10296625
Aroclor-1221 (PCB-1221)	FL	8885	10296625
Aroclor-1232 (PCB-1232)	FL	8890	10296625
Aroclor-1242 (PCB-1242)	FL	8895	10296625
Aroclor-1248 (PCB-1248)	FL	8900	10296625
Aroclor-1254 (PCB-1254)	FL	8905	10296625
Aroclor-1260 (PCB-1260)	FL	8910	10296625
beta-BHC (beta-Hexachlorocyclohexane)	FL	7115	10296625
Chlordane (tech.)	FL	7250	10296625
delta-BHC (delta-Hexachlorocyclohexane)	FL	7105	10296625
Dieldrin	FL	7470	10296625

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Matrix: ***Non-Potable Water***

Endosulfan I	FL	7510	10296625
Endosulfan II	FL	7515	10296625
Endosulfan sulfate	FL	7520	10296625
Endrin	FL	7540	10296625
Endrin aldehyde	FL	7530	10296625
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	FL	7120	10296625
Heptachlor	FL	7685	10296625
Heptachlor epoxide	FL	7690	10296625
Toxaphene (Chlorinated camphene)	FL	8250	10296625

Method EPA 624.1

Analyte	**AB**	**Analyte ID**	**Method ID**
1,1,1-Trichloroethane	FL	5160	10298121
1,1,2,2-Tetrachloroethane	FL	5110	10298121
1,1,2-Trichloroethane	FL	5165	10298121
1,1-Dichloroethane	FL	4630	10298121
1,1-Dichloroethylene	FL	4640	10298121
1,2-Dichlorobenzene	FL	4610	10298121
1,2-Dichloroethane (Ethylene dichloride)	FL	4635	10298121
1,2-Dichloropropane	FL	4655	10298121
1,3-Dichlorobenzene	FL	4615	10298121
1,4-Dichlorobenzene	FL	4620	10298121
2-Chloroethyl vinyl ether	FL	4500	10298121
Acrolein (Propenal)	FL	4325	10298121
Acrylonitrile	FL	4340	10298121
Benzene	FL	4375	10298121
Bromodichloromethane	FL	4395	10298121
Bromoform	FL	4400	10298121
Carbon tetrachloride	FL	4455	10298121
Chlorobenzene	FL	4475	10298121
Chlorodibromomethane	FL	4575	10298121

Matrix: ***Non-Potable Water***

Chloroethane (Ethyl chloride)	FL	4485	10298121
Chloroform	FL	4505	10298121
cis-1,3-Dichloropropene	FL	4680	10298121
Ethylbenzene	FL	4765	10298121
Methyl bromide (Bromomethane)	FL	4950	10298121
Methyl chloride (Chloromethane)	FL	4960	10298121
Methyl tert-butyl ether (MTBE)	FL	5000	10298121
Methylene chloride (Dichloromethane)	FL	4975	10298121
Tetrachloroethylene (Perchloroethylene)	FL	5115	10298121
Toluene	FL	5140	10298121
trans-1,2-Dichloroethylene	FL	4700	10298121
trans-1,3-Dichloropropylene	FL	4685	10298121
Trichloroethene (Trichloroethylene)	FL	5170	10298121
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	FL	5175	10298121
Vinyl chloride	FL	5235	10298121
Xylene (total)	FL	5260	10298121

Method EPA 625.1

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2,4-Trichlorobenzene	FL	5155	10300024
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	FL	4659	10300024
2,4,6-Trichlorophenol	FL	6840	10300024
2,4-Dichlorophenol	FL	6000	10300024
2,4-Dimethylphenol	FL	6130	10300024
2,4-Dinitrophenol	FL	6175	10300024
2,4-Dinitrotoluene (2,4-DNT)	FL	6185	10300024
2,6-Dinitrotoluene (2,6-DNT)	FL	6190	10300024
2-Chloronaphthalene	FL	5795	10300024
2-Chlorophenol	FL	5800	10300024
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	FL	6360	10300024
2-Nitrophenol	FL	6490	10300024

Matrix: ***Non-Potable Water***

3,3'-Dichlorobenzidine	FL	5945	10300024
4-Bromophenyl phenyl ether (BDE-3)	FL	5660	10300024
4-Chloro-3-methylphenol	FL	5700	10300024
4-Chlorophenyl phenylether	FL	5825	10300024
4-Nitrophenol	FL	6500	10300024
Acenaphthene	FL	5500	10300024
Acenaphthylene	FL	5505	10300024
Anthracene	FL	5555	10300024
Benzidine	FL	5595	10300024
Benzo(a)anthracene	FL	5575	10300024
Benzo(a)pyrene	FL	5580	10300024
Benzo(b)fluoranthene	FL	5585	10300024
Benzo(g,h,i)perylene	FL	5590	10300024
Benzo(k)fluoranthene	FL	5600	10300024
bis(2-Chloroethoxy)methane	FL	5760	10300024
bis(2-Chloroethyl) ether	FL	5765	10300024
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	FL	6065	10300024
Butyl benzyl phthalate	FL	5670	10300024
Chrysene	FL	5855	10300024
Dibenz(a,h) anthracene	FL	5895	10300024
Diethyl phthalate	FL	6070	10300024
Dimethyl phthalate	FL	6135	10300024
Di-n-butyl phthalate	FL	5925	10300024
Di-n-octyl phthalate	FL	6200	10300024
Fluoranthene	FL	6265	10300024
Fluorene	FL	6270	10300024
Hexachlorobenzene	FL	6275	10300024
Hexachlorobutadiene	FL	4835	10300024
Hexachlorocyclopentadiene	FL	6285	10300024
Hexachloroethane	FL	4840	10300024

Matrix: ***Non-Potable Water***

Indeno(1,2,3-cd) pyrene	FL	6315	10300024
Isophorone	FL	6320	10300024
Naphthalene	FL	5005	10300024
Nitrobenzene	FL	5015	10300024
n-Nitrosodimethylamine	FL	6530	10300024
n-Nitrosodi-n-propylamine	FL	6545	10300024
n-Nitrosodiphenylamine	FL	6535	10300024
Pentachlorophenol	FL	6605	10300024
Phenanthrene	FL	6615	10300024
Phenol	FL	6625	10300024
Pyrene	FL	6665	10300024

Method EPA 7196

Analyte	**AB**	**Analyte ID**	**Method ID**
Chromium (VI)	FL	1045	10162206

Method EPA 7470

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	FL	1095	10165603

Method EPA 8011

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2-Dibromo-3-chloropropane (DBCP)	FL	4570	10173009
1,2-Dibromoethane (EDB, Ethylene dibromide)	FL	4585	10173009

Method EPA 8015

Analyte	**AB**	**Analyte ID**	**Method ID**
Diesel range organics (DRO)	FL	9369	10173203
Ethanol	FL	4750	10173203
Gasoline range organics (GRO)	FL	9408	10173203
Isobutyl alcohol (2-Methyl-1-propanol)	FL	4875	10173203
Isopropyl alcohol (2-Propanol, Isopropanol)	FL	4895	10173203
Methanol	FL	4930	10173203
n-Butyl alcohol (1-Butanol, n-Butanol)	FL	4425	10173203
n-Propanol (1-Propanol)	FL	5055	10173203

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

SGS North America Inc. – Orlando

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Matrix: ***Non-Potable Water***

Method EPA 8081

Analyte	AB	Analyte ID	Method ID
4,4'-DDD	FL	7355	10178402
4,4'-DDE	FL	7360	10178402
4,4'-DDT	FL	7365	10178402
Aldrin	FL	7025	10178402
alpha-BHC (alpha-Hexachlorocyclohexane)	FL	7110	10178402
alpha-Chlordane	FL	7240	10178402
beta-BHC (beta-Hexachlorocyclohexane)	FL	7115	10178402
Chlordane (tech.)	FL	7250	10178402
delta-BHC (delta-Hexachlorocyclohexane)	FL	7105	10178402
Dieldrin	FL	7470	10178402
Endosulfan I	FL	7510	10178402
Endosulfan II	FL	7515	10178402
Endosulfan sulfate	FL	7520	10178402
Endrin	FL	7540	10178402
Endrin aldehyde	FL	7530	10178402
Endrin ketone	FL	7535	10178402
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	FL	7120	10178402
gamma-Chlordane	FL	7245	10178402
Heptachlor	FL	7685	10178402
Heptachlor epoxide	FL	7690	10178402
Methoxychlor	FL	7810	10178402
Toxaphene (Chlorinated camphene)	FL	8250	10178402

Method EPA 8082

Analyte	AB	Analyte ID	Method ID
Aroclor-1016 (PCB-1016)	FL	8880	10179007
Aroclor-1221 (PCB-1221)	FL	8885	10179007
Aroclor-1232 (PCB-1232)	FL	8890	10179007
Aroclor-1242 (PCB-1242)	FL	8895	10179007
Aroclor-1248 (PCB-1248)	FL	8900	10179007

Matrix: ***Non-Potable Water***

Aroclor-1254 (PCB-1254)	FL	8905	10179007
Aroclor-1260 (PCB-1260)	FL	8910	10179007

Method EPA 8141

Analyte	**AB**	**Analyte ID**	**Method ID**
Azinphos-methyl (Guthion)	FL	7075	10181803
Bolstar (Sulprofos)	FL	7125	10181803
Carbophenothion	FL	7220	10181803
Chlorpyrifos (Dursban)	FL	7300	10181803
Coumaphos	FL	7315	10181803
Demeton-o	FL	7395	10181803
Demeton-s	FL	7385	10181803
Diazinon	FL	7410	10181803
Dichlorovos (DDVP, Dichlorvos)	FL	8610	10181803
Dimethoate	FL	7475	10181803
Disulfoton	FL	8625	10181803
EPN (Phosphonothioic acid, phenyl-, O-ethyl O-(p-nitrophenyl) ester)	FL	7550	10181803
Ethion	FL	7565	10181803
Ethoprop	FL	7570	10181803
Famphur	FL	7580	10181803
Fensulfothion	FL	7600	10181803
Fenthion	FL	7605	10181803
Malathion	FL	7770	10181803
Merphos	FL	7785	10181803
Methyl parathion (Parathion, methyl)	FL	7825	10181803
Mevinphos	FL	7850	10181803
Monocrotophos	FL	7880	10181803
Naled	FL	7905	10181803
Parathion, ethyl	FL	7955	10181803
Phorate	FL	7985	10181803
Ronnel	FL	8110	10181803

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Matrix: ***Non-Potable Water***

Sulfotepp	FL	8155	10181803
Tetrachlorvinphos (Stirophos, Gardona)	FL	8197	10181803
Tetraethyl pyrophosphate (TEPP)	FL	8210	10181803
Thionazin (Zinophos)	FL	8235	10181803
Tokuthion (Prothiophos)	FL	8245	10181803
Trichloronate	FL	8275	10181803

Method EPA 8151

Analyte	AB	Analyte ID	Method ID
2,4,5-T	FL	8655	10183003
2,4-D	FL	8545	10183003
2,4-DB	FL	8560	10183003
Dalapon	FL	8555	10183003
Dicamba	FL	8595	10183003
Dichloroprop (Dichlorprop, Weedone)	FL	8605	10183003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	FL	8620	10183003
MCPA	FL	7775	10183003
MCPP	FL	7780	10183003
Pentachlorophenol	FL	6605	10183003
Silvex (2,4,5-TP)	FL	8650	10183003

Method EPA 8260

Analyte	AB	Analyte ID	Method ID
1,1,1,2-Tetrachloroethane	FL	5105	10184404
1,1,1-Trichloroethane	FL	5160	10184404
1,1,2,2-Tetrachloroethane	FL	5110	10184404
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	FL	5195	10184404
1,1,2-Trichloroethane	FL	5165	10184404
1,1-Dichloroethane	FL	4630	10184404
1,1-Dichloroethylene	FL	4640	10184404
1,1-Dichloropropene	FL	4670	10184404
1,2,3-Trichlorobenzene	FL	5150	10184404
1,2,3-Trichloropropane	FL	5180	10184404

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Matrix: ***Non-Potable Water***

1,2,4-Trichlorobenzene	FL	5155	10184404
1,2,4-Trimethylbenzene	FL	5210	10184404
1,2-Dibromo-3-chloropropane (DBCP)	FL	4570	10184404
1,2-Dibromoethane (EDB, Ethylene dibromide)	FL	4585	10184404
1,2-Dichlorobenzene	FL	4610	10184404
1,2-Dichloroethane (Ethylene dichloride)	FL	4635	10184404
1,2-Dichloropropane	FL	4655	10184404
1,3,5-Trimethylbenzene	FL	5215	10184404
1,3-Dichlorobenzene	FL	4615	10184404
1,3-Dichloropropane	FL	4660	10184404
1,4-Dichlorobenzene	FL	4620	10184404
1,4-Dioxane (1,4-Diethyleneoxide)	FL	4735	10184404
1-Chlorohexane	FL	4510	10184404
2,2-Dichloropropane	FL	4665	10184404
2-Butanone (Methyl ethyl ketone, MEK)	FL	4410	10184404
2-Chloroethyl vinyl ether	FL	4500	10184404
2-Chlorotoluene	FL	4535	10184404
2-Hexanone (MBK)	FL	4860	10184404
2-Nitropropane	FL	5020	10184404
4-Chlorotoluene	FL	4540	10184404
4-Isopropyltoluene (p-Cymene)	FL	4915	10184404
4-Methyl-2-pentanone (MIBK)	FL	4995	10184404
Acetone (2-Propanone)	FL	4315	10184404
Acetonitrile	FL	4320	10184404
Acrolein (Propenal)	FL	4325	10184404
Acrylonitrile	FL	4340	10184404
Allyl chloride (3-Chloropropene)	FL	4355	10184404
Benzene	FL	4375	10184404
Bromobenzene	FL	4385	10184404
Bromochloromethane	FL	4390	10184404

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Matrix: ***Non-Potable Water***

Bromodichloromethane	FL	4395	10184404
Bromoform	FL	4400	10184404
Carbon disulfide	FL	4450	10184404
Carbon tetrachloride	FL	4455	10184404
Chlorobenzene	FL	4475	10184404
Chlorodibromomethane	FL	4575	10184404
Chloroethane (Ethyl chloride)	FL	4485	10184404
Chloroform	FL	4505	10184404
Chloroprene (2-Chloro-1,3-butadiene)	FL	4525	10184404
cis-1,2-Dichloroethylene	FL	4645	10184404
cis-1,3-Dichloropropene	FL	4680	10184404
cis-1,4-Dichloro-2-butene	FL	4600	10184404
Dibromomethane (Methylene bromide)	FL	4595	10184404
Dichlorodifluoromethane (Freon-12)	FL	4625	10184404
Diethyl ether	FL	4725	10184404
Di-isopropylether (DIPE)	FL	9375	10184404
Ethanol	FL	4750	10184404
Ethyl acetate	FL	4755	10184404
Ethyl methacrylate	FL	4810	10184404
Ethylbenzene	FL	4765	10184404
Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)	FL	4770	10184404
Hexachlorobutadiene	FL	4835	10184404
Iodomethane (Methyl iodide)	FL	4870	10184404
Isobutyl alcohol (2-Methyl-1-propanol)	FL	4875	10184404
Isopropyl alcohol (2-Propanol, Isopropanol)	FL	4895	10184404
Isopropylbenzene (Cumene)	FL	4900	10184404
Methacrylonitrile	FL	4925	10184404
Methyl bromide (Bromomethane)	FL	4950	10184404
Methyl chloride (Chloromethane)	FL	4960	10184404
Methyl methacrylate	FL	4990	10184404

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Matrix: ***Non-Potable Water***

Methyl tert-butyl ether (MTBE)	FL	5000	10184404
Methylene chloride (Dichloromethane)	FL	4975	10184404
Naphthalene	FL	5005	10184404
n-Butyl alcohol (1-Butanol, n-Butanol)	FL	4425	10184404
n-Butylbenzene	FL	4435	10184404
n-Propylbenzene	FL	5090	10184404
Pentachloroethane	FL	5035	10184404
Propionitrile (Ethyl cyanide)	FL	5080	10184404
sec-Butylbenzene	FL	4440	10184404
Styrene	FL	5100	10184404
T-amylmethylether (TAME)	FL	4370	10184404
tert-Butyl alcohol	FL	4420	10184404
tert-Butylbenzene	FL	4445	10184404
Tetrachloroethylene (Perchloroethylene)	FL	5115	10184404
Toluene	FL	5140	10184404
trans-1,2-Dichloroethylene	FL	4700	10184404
trans-1,3-Dichloropropylene	FL	4685	10184404
trans-1,4-Dichloro-2-butene	FL	4605	10184404
Trichloroethene (Trichloroethylene)	FL	5170	10184404
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	FL	5175	10184404
Vinyl acetate	FL	5225	10184404
Vinyl chloride	FL	5235	10184404
Xylene (total)	FL	5260	10184404

Method EPA 8270

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2,4,5-Tetrachlorobenzene	FL	6715	10185203
1,2,4-Trichlorobenzene	FL	5155	10185203
1,2-Dichlorobenzene	FL	4610	10185203
1,2-Diphenylhydrazine	FL	6220	10185203
1,3,5-Trinitrobenzene (1,3,5-TNB)	FL	6885	10185203

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Matrix: ***Non-Potable Water***

1,3-Dichlorobenzene	FL	4615	10185203
1,3-Dinitrobenzene (1,3-DNB)	FL	6160	10185203
1,4-Dichlorobenzene	FL	4620	10185203
1,4-Naphthoquinone	FL	6420	10185203
1,4-Phenylenediamine	FL	6630	10185203
1-Chloronaphthalene	FL	5790	10185203
1-Naphthylamine	FL	6425	10185203
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	FL	4659	10185203
2,3,4,6-Tetrachlorophenol	FL	6735	10185203
2,4,5-Trichlorophenol	FL	6835	10185203
2,4,6-Trichlorophenol	FL	6840	10185203
2,4-Dichlorophenol	FL	6000	10185203
2,4-Dimethylphenol	FL	6130	10185203
2,4-Dinitrophenol	FL	6175	10185203
2,4-Dinitrotoluene (2,4-DNT)	FL	6185	10185203
2,6-Dichlorophenol	FL	6005	10185203
2,6-Dinitrotoluene (2,6-DNT)	FL	6190	10185203
2-Acetylaminofluorene	FL	5515	10185203
2-Chloronaphthalene	FL	5795	10185203
2-Chlorophenol	FL	5800	10185203
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	FL	6360	10185203
2-Methylaniline (o-Toluidine)	FL	5145	10185203
2-Methylnaphthalene	FL	6385	10185203
2-Methylphenol (o-Cresol)	FL	6400	10185203
2-Naphthylamine	FL	6430	10185203
2-Nitroaniline	FL	6460	10185203
2-Nitrophenol	FL	6490	10185203
2-Picoline (2-Methylpyridine)	FL	5050	10185203
3,3'-Dichlorobenzidine	FL	5945	10185203
3,3'-Dimethylbenzidine	FL	6120	10185203

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Matrix: ***Non-Potable Water***

3-Methylcholanthrene	FL	6355	10185203
3-Methylphenol (m-Cresol)	FL	6405	10185203
3-Nitroaniline	FL	6465	10185203
4-Aminobiphenyl	FL	5540	10185203
4-Bromophenyl phenyl ether (BDE-3)	FL	5660	10185203
4-Chloro-3-methylphenol	FL	5700	10185203
4-Chloroaniline	FL	5745	10185203
4-Chlorophenyl phenylether	FL	5825	10185203
4-Dimethyl aminoazobenzene	FL	6105	10185203
4-Methylphenol (p-Cresol)	FL	6410	10185203
4-Nitroaniline	FL	6470	10185203
4-Nitrophenol	FL	6500	10185203
4-Nitroquinoline-1-oxide	FL	6510	10185203
5-Nitro-o-toluidine	FL	6570	10185203
7,12-Dimethylbenz(a) anthracene	FL	6115	10185203
a-a-Dimethylphenethylamine	FL	6125	10185203
Acenaphthene	FL	5500	10185203
Acenaphthylene	FL	5505	10185203
Acetophenone	FL	5510	10185203
Aniline	FL	5545	10185203
Anthracene	FL	5555	10185203
Aramite	FL	5560	10185203
Atrazine	FL	7065	10185203
Benzenethiol (Thiophenol)	FL	6750	10186002
Benzidine	FL	5595	10185203
Benzo(a)anthracene	FL	5575	10185203
Benzo(a)pyrene	FL	5580	10185203
Benzo(b)fluoranthene	FL	5585	10185203
Benzo(g,h,i)perylene	FL	5590	10185203
Benzo(k)fluoranthene	FL	5600	10185203

Matrix: ***Non-Potable Water***

Benzoic acid	FL	5610	10185203
Benzyl alcohol	FL	5630	10185203
Biphenyl	FL	5640	10185203
bis(2-Chloroethoxy)methane	FL	5760	10185203
bis(2-Chloroethyl) ether	FL	5765	10185203
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	FL	6065	10185203
Butyl benzyl phthalate	FL	5670	10185203
Caprolactam	FL	7180	10185203
Carbazole	FL	5680	10185203
Chlorobenzilate	FL	7260	10185203
Chrysene	FL	5855	10185203
Diallate	FL	7405	10185203
Dibenz(a,h) anthracene	FL	5895	10185203
Dibenz(a,j) acridine	FL	5900	10185203
Dibenzofuran	FL	5905	10185203
Diethyl phthalate	FL	6070	10185203
Dimethoate	FL	7475	10185203
Dimethyl phthalate	FL	6135	10185203
Di-n-butyl phthalate	FL	5925	10185203
Di-n-octyl phthalate	FL	6200	10185203
Diphenylamine	FL	6205	10185203
Disulfoton	FL	8625	10185203
Ethyl methanesulfonate	FL	6260	10185203
Famphur	FL	7580	10185203
Fluoranthene	FL	6265	10185203
Fluorene	FL	6270	10185203
Hexachlorobenzene	FL	6275	10185203
Hexachlorobutadiene	FL	4835	10185203
Hexachlorocyclopentadiene	FL	6285	10185203
Hexachloroethane	FL	4840	10185203

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Matrix: ***Non-Potable Water***

Hexachlorophene	FL	6290	10185203
Hexachloropropene	FL	6295	10185203
Indeno(1,2,3-cd) pyrene	FL	6315	10185203
Isodrin	FL	7725	10185203
Isophorone	FL	6320	10185203
Isosafrole	FL	6325	10185203
Kepone	FL	7740	10185203
Methapyrilene	FL	6345	10185203
Methyl methanesulfonate	FL	6375	10185203
Methyl parathion (Parathion, methyl)	FL	7825	10185203
Naphthalene	FL	5005	10185203
Nitrobenzene	FL	5015	10185203
n-Nitrosodiethylamine	FL	6525	10185203
n-Nitrosodimethylamine	FL	6530	10185203
n-Nitrosodi-n-butylamine	FL	5025	10185203
n-Nitrosodi-n-propylamine	FL	6545	10185203
n-Nitrosodiphenylamine	FL	6535	10185203
n-Nitrosomethylethylamine	FL	6550	10185203
n-Nitrosomorpholine	FL	6555	10185203
n-Nitrosopiperidine	FL	6560	10185203
n-Nitrosopyrrolidine	FL	6565	10185203
o,o,o-Triethyl phosphorothioate	FL	8290	10185203
Parathion, ethyl	FL	7955	10185203
Pentachlorobenzene	FL	6590	10185203
Pentachloronitrobenzene (PCNB)	FL	6600	10185203
Pentachlorophenol	FL	6605	10185203
Phenacetin	FL	6610	10185203
Phenanthrene	FL	6615	10185203
Phenol	FL	6625	10185203
Phorate	FL	7985	10185203

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Matrix: ***Non-Potable Water***

Pronamide (Kerb)	FL	6650	10185203
Pyrene	FL	6665	10185203
Pyridine	FL	5095	10185203
Quinoline	FL	6670	10185203
Safrole	FL	6685	10185203
Sulfotepp	FL	8155	10185203
Thionazin (Zinophos)	FL	8235	10185203

Method EPA 8316

Analyte	**AB**	**Analyte ID**	**Method ID**
Acrylamide	FL	4330	10188202

Method EPA 8330

Analyte	**AB**	**Analyte ID**	**Method ID**
1,3,5-Trinitrobenzene (1,3,5-TNB)	FL	6885	10189807
1,3-Dinitrobenzene (1,3-DNB)	FL	6160	10189807
2,4,6-Trinitrotoluene (2,4,6-TNT)	FL	9651	10189807
2,4-Dinitrotoluene (2,4-DNT)	FL	6185	10189807
2,6-Dinitrotoluene (2,6-DNT)	FL	6190	10189807
2-Amino-4,6-dinitrotoluene (2-am-dnt)	FL	9303	10189807
2-Nitrotoluene	FL	9507	10189807
3-Nitrotoluene	FL	9510	10189807
4-Amino-2,6-dinitrotoluene (4-am-dnt)	FL	9306	10189807
4-Nitrotoluene	FL	9513	10189807
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	FL	6415	10189807
Nitrobenzene	FL	5015	10189807
Nitroglycerin	FL	6485	10189807
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	FL	9522	10189807
Pentaerythritoltetranitrate (PETN)	FL	9558	10189807
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	FL	9432	10189807

Method EPA 8332

Analyte	**AB**	**Analyte ID**	**Method ID**
Nitroglycerin	FL	6485	10190406

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Matrix: ***Non-Potable Water***

Method EPA 9012

Analyte	AB	Analyte ID	Method ID
Total cyanide	FL	1645	10193405

Method EPA 9040

Analyte	AB	Analyte ID	Method ID
pH	FL	1900	10196802

Method EPA 9056

Analyte	AB	Analyte ID	Method ID
Bromide	FL	1540	10199209
Chloride	FL	1575	10199209
Fluoride	FL	1730	10199209
Nitrate as N	FL	1810	10199209
Nitrate-nitrite	FL	1820	10199209
Nitrite as N	FL	1840	10199209
Orthophosphate as P	FL	1870	10199209
Sulfate	FL	2000	10199209

Method EPA 9060

Analyte	AB	Analyte ID	Method ID
Total Organic Carbon (TOC)	FL	2040	10200201

Method EPA 9070

Analyte	AB	Analyte ID	Method ID
n-Hexane Extractable Material (HEM) (O&G)	FL	1803	10201000

Method EPA RSK 175

Analyte	AB	Analyte ID	Method ID
Ethane	FL	4747	10212905
Ethene	FL	4752	10212905
Methane	FL	4926	10212905
n-Propane	FL	5029	10212905

Method IDNR OA-1; GRO

Analyte	AB	Analyte ID	Method ID
Volatile Petroleum Hydrocarbons (Gasoline)	FL	10330	90016403

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Matrix: ***Non-Potable Water***

Method IDNR OA-2; DRO

Analyte	**AB**	**Analyte ID**	**Method ID**
Extractable Petroleum Hydrocarbons (EPH)	FL	10331	90016607

Method SM 2120 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Color	FL	1605	20223807

Method SM 2320 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Alkalinity as CaCO3	FL	1505	20045005

Method SM 2340 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Total hardness as CaCO3	FL	1755	20046008

Method SM 2540 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Residue-total (total solids)	FL	1950	20004608

Method SM 2540 C

Analyte	**AB**	**Analyte ID**	**Method ID**
Residue-filterable (TDS)	FL	1955	20049803

Method SM 2540 D

Analyte	**AB**	**Analyte ID**	**Method ID**
Residue-nonfilterable (TSS)	FL	1960	20004802

Method SM 4500-H+ B

Analyte	**AB**	**Analyte ID**	**Method ID**
pH	FL	1900	20104603

Method SM 4500-S2¯ F

Analyte	**AB**	**Analyte ID**	**Method ID**
Sulfide	FL	2005	20126209

Method SM 5210 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Biochemical oxygen demand (BOD)	FL	1530	20027401
Carbonaceous BOD, CBOD	FL	1555	20027401

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Matrix: ***Non-Potable Water***

Method SM 5220 C

Analyte	AB	Analyte ID	Method ID
Chemical oxygen demand (COD)	FL	1565	20027605

Method SM 5310 B

Analyte	AB	Analyte ID	Method ID
Total Organic Carbon (TOC)	FL	2040	20137206

Method TCEQ 1005

Analyte	AB	Analyte ID	Method ID
Total Petroleum Hydrocarbons (TPH)	FL	2050	90019208

Method Tennessee EPH

Analyte	AB	Analyte ID	Method ID
Extractable Petroleum Hydrocarbons (EPH)	FL	10331	Tennessee-EPH

Method Tennessee GRO

Analyte	AB	Analyte ID	Method ID
Gasoline range organics (GRO)	FL	9408	60053307

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Matrix: ***Solid & Chemical Materials***

Method EPA 1010

Analyte	AB	Analyte ID	Method ID
Ignitability	FL	1780	10116606

Method EPA 1020

Analyte	AB	Analyte ID	Method ID
Ignitability	FL	1780	10117007

Method EPA 1311

Analyte	AB	Analyte ID	Method ID
TCLP	FL	849	10118806

Method EPA 1312

Analyte	AB	Analyte ID	Method ID
SPLP	FL	850	10119003

Method EPA 350.1

Analyte	AB	Analyte ID	Method ID
Ammonia as N	FL	1515	10063408

Method EPA 365.3

Analyte	AB	Analyte ID	Method ID
Phosphorus	FL	1910	10070801

Method EPA 6010

Analyte	AB	Analyte ID	Method ID
Aluminum	FL	1000	10155201
Antimony	FL	1005	10155201
Arsenic	FL	1010	10155201
Barium	FL	1015	10155201
Beryllium	FL	1020	10155201
Cadmium	FL	1030	10155201
Calcium	FL	1035	10155201
Chromium	FL	1040	10155201
Cobalt	FL	1050	10155201
Copper	FL	1055	10155201
Iron	FL	1070	10155201

Matrix: ***Solid & Chemical Materials***

Lead	FL	1075	10155201
Magnesium	FL	1085	10155201
Manganese	FL	1090	10155201
Molybdenum	FL	1100	10155201
Nickel	FL	1105	10155201
Potassium	FL	1125	10155201
Selenium	FL	1140	10155201
Silver	FL	1150	10155201
Sodium	FL	1155	10155201
Strontium	FL	1160	10155201
Thallium	FL	1165	10155201
Tin	FL	1175	10155201
Titanium	FL	1180	10155201
Vanadium	FL	1185	10155201
Zinc	FL	1190	10155201

Method EPA 6020

Analyte	**AB**	**Analyte ID**	**Method ID**
Aluminum	FL	1000	10156419
Antimony	FL	1005	10156419
Arsenic	FL	1010	10156419
Barium	FL	1015	10156419
Beryllium	FL	1020	10156419
Cadmium	FL	1030	10156419
Calcium	FL	1035	10156419
Chromium	FL	1040	10156419
Cobalt	FL	1050	10156419
Copper	FL	1055	10156419
Iron	FL	1070	10156419
Lead	FL	1075	10156419
Magnesium	FL	1085	10156419

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Matrix: ***Solid & Chemical Materials***

Manganese	FL	1090	10156419
Molybdenum	FL	1100	10156419
Nickel	FL	1105	10156419
Potassium	FL	1125	10156419
Selenium	FL	1140	10156419
Silver	FL	1150	10156419
Sodium	FL	1155	10156419
Strontium	FL	1160	10156419
Thallium	FL	1165	10156419
Tin	FL	1175	10156419
Titanium	FL	1180	10156419
Vanadium	FL	1185	10156419
Zinc	FL	1190	10156419

Method EPA 7196

Analyte	**AB**	**Analyte ID**	**Method ID**
Chromium (VI)	FL	1045	10162206

Method EPA 7471

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	FL	1095	10166004

Method EPA 8011

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2-Dibromo-3-chloropropane (DBCP)	FL	4570	10173009
1,2-Dibromoethane (EDB, Ethylene dibromide)	FL	4585	10173009

Method EPA 8015

Analyte	**AB**	**Analyte ID**	**Method ID**
Diesel range organics (DRO)	FL	9369	10173203
Ethanol	FL	4750	10173203
Gasoline range organics (GRO)	FL	9408	10173203
Isobutyl alcohol (2-Methyl-1-propanol)	FL	4875	10173203
Isopropyl alcohol (2-Propanol, Isopropanol)	FL	4895	10173203
Methanol	FL	4930	10173203

Matrix: ***Solid & Chemical Materials***

n-Butyl alcohol (1-Butanol, n-Butanol)	FL	4425	10173203
n-Propanol (1-Propanol)	FL	5055	10173203

Method EPA 8081

Analyte	**AB**	**Analyte ID**	**Method ID**
4,4'-DDD	FL	7355	10178402
4,4'-DDE	FL	7360	10178402
4,4'-DDT	FL	7365	10178402
Aldrin	FL	7025	10178402
alpha-BHC (alpha-Hexachlorocyclohexane)	FL	7110	10178402
alpha-Chlordane	FL	7240	10178402
beta-BHC (beta-Hexachlorocyclohexane)	FL	7115	10178402
Chlordane (tech.)	FL	7250	10178402
delta-BHC (delta-Hexachlorocyclohexane)	FL	7105	10178402
Dieldrin	FL	7470	10178402
Endosulfan I	FL	7510	10178402
Endosulfan II	FL	7515	10178402
Endosulfan sulfate	FL	7520	10178402
Endrin	FL	7540	10178402
Endrin aldehyde	FL	7530	10178402
Endrin ketone	FL	7535	10178402
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	FL	7120	10178402
gamma-Chlordane	FL	7245	10178402
Heptachlor	FL	7685	10178402
Heptachlor epoxide	FL	7690	10178402
Methoxychlor	FL	7810	10178402
Toxaphene (Chlorinated camphene)	FL	8250	10178402

Method EPA 8082

Analyte	**AB**	**Analyte ID**	**Method ID**
Aroclor-1016 (PCB-1016)	FL	8880	10179007
Aroclor-1221 (PCB-1221)	FL	8885	10179007
Aroclor-1232 (PCB-1232)	FL	8890	10179007

Matrix: ***Solid & Chemical Materials***

Aroclor-1242 (PCB-1242)	FL	8895	10179007
Aroclor-1248 (PCB-1248)	FL	8900	10179007
Aroclor-1254 (PCB-1254)	FL	8905	10179007
Aroclor-1260 (PCB-1260)	FL	8910	10179007

Method EPA 8141

Analyte	AB	Analyte ID	Method ID
Azinphos-methyl (Guthion)	FL	7075	10181803
Bolstar (Sulprofos)	FL	7125	10181803
Carbophenothion	FL	7220	10181803
Chlorpyrifos (Dursban)	FL	7300	10181803
Coumaphos	FL	7315	10181803
Demeton-o	FL	7395	10181803
Demeton-s	FL	7385	10181803
Diazinon	FL	7410	10181803
Dichlorovos (DDVP, Dichlorvos)	FL	8610	10181803
Dimethoate	FL	7475	10181803
Disulfoton	FL	8625	10181803
EPN (Phosphonothioic acid, phenyl-, O-ethyl O-(p-nitrophenyl) ester)	FL	7550	10181803
Ethion	FL	7565	10181803
Ethoprop	FL	7570	10181803
Famphur	FL	7580	10181803
Fensulfothion	FL	7600	10181803
Fenthion	FL	7605	10181803
Malathion	FL	7770	10181803
Merphos	FL	7785	10181803
Methyl parathion (Parathion, methyl)	FL	7825	10182000
Mevinphos	FL	7850	10181803
Monocrotophos	FL	7880	10181803
Naled	FL	7905	10181803
Parathion, ethyl	FL	7955	10181803

Matrix: ***Solid & Chemical Materials***

Phorate	FL	7985	10181803
Ronnel	FL	8110	10181803
Sulfotepp	FL	8155	10181803
Tetrachlorvinphos (Stirophos, Gardona)	FL	8197	10181803
Tetraethyl pyrophosphate (TEPP)	FL	8210	10181803
Thionazin (Zinophos)	FL	8235	10181803
Tokuthion (Prothiophos)	FL	8245	10181803
Trichloronate	FL	8275	10181803

Method EPA 8151

Analyte	**AB**	**Analyte ID**	**Method ID**
2,4,5-T	FL	8655	10183003
2,4-D	FL	8545	10183003
2,4-DB	FL	8560	10183003
Dalapon	FL	8555	10183003
Dicamba	FL	8595	10183003
Dichloroprop (Dichlorprop, Weedone)	FL	8605	10183003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	FL	8620	10183003
MCPA	FL	7775	10183003
MCPP	FL	7780	10183003
Pentachlorophenol	FL	6605	10183003
Silvex (2,4,5-TP)	FL	8650	10183003

Method EPA 8260

Analyte	**AB**	**Analyte ID**	**Method ID**
1,1,1,2-Tetrachloroethane	FL	5105	10184404
1,1,1-Trichloroethane	FL	5160	10184404
1,1,2,2-Tetrachloroethane	FL	5110	10184404
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	FL	5195	10184404
1,1,2-Trichloroethane	FL	5165	10184404
1,1-Dichloroethane	FL	4630	10184404
1,1-Dichloroethylene	FL	4640	10184404
1,1-Dichloropropene	FL	4670	10184404

Matrix: ***Solid & Chemical Materials***

1,2,3-Trichlorobenzene	FL	5150	10184404
1,2,3-Trichloropropane	FL	5180	10184404
1,2,4-Trichlorobenzene	FL	5155	10184404
1,2,4-Trimethylbenzene	FL	5210	10184404
1,2-Dibromo-3-chloropropane (DBCP)	FL	4570	10184404
1,2-Dibromoethane (EDB, Ethylene dibromide)	FL	4585	10184404
1,2-Dichlorobenzene	FL	4610	10184404
1,2-Dichloroethane (Ethylene dichloride)	FL	4635	10184404
1,2-Dichloropropane	FL	4655	10184404
1,3,5-Trimethylbenzene	FL	5215	10184404
1,3-Dichlorobenzene	FL	4615	10184404
1,3-Dichloropropane	FL	4660	10184404
1,4-Dichlorobenzene	FL	4620	10184404
1,4-Dioxane (1,4-Diethyleneoxide)	FL	4735	10184404
1-Chlorohexane	FL	4510	10184404
2,2-Dichloropropane	FL	4665	10184404
2-Butanone (Methyl ethyl ketone, MEK)	FL	4410	10184404
2-Chloroethyl vinyl ether	FL	4500	10184404
2-Chlorotoluene	FL	4535	10184404
2-Hexanone (MBK)	FL	4860	10184404
2-Nitropropane	FL	5020	10184404
4-Chlorotoluene	FL	4540	10184404
4-Isopropyltoluene (p-Cymene)	FL	4915	10184404
4-Methyl-2-pentanone (MIBK)	FL	4995	10184404
Acetone (2-Propanone)	FL	4315	10184404
Acetonitrile	FL	4320	10184404
Acrolein (Propenal)	FL	4325	10184404
Acrylonitrile	FL	4340	10184404
Allyl chloride (3-Chloropropene)	FL	4355	10184404
Benzene	FL	4375	10184404

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Matrix: ***Solid & Chemical Materials***

Bromobenzene	FL	4385	10184404
Bromochloromethane	FL	4390	10184404
Bromodichloromethane	FL	4395	10184404
Bromoform	FL	4400	10184404
Carbon disulfide	FL	4450	10184404
Carbon tetrachloride	FL	4455	10184404
Chlorobenzene	FL	4475	10184404
Chlorodibromomethane	FL	4575	10184404
Chloroethane (Ethyl chloride)	FL	4485	10184404
Chloroform	FL	4505	10184404
Chloroprene (2-Chloro-1,3-butadiene)	FL	4525	10184404
cis-1,2-Dichloroethylene	FL	4645	10184404
cis-1,3-Dichloropropene	FL	4680	10184404
cis-1,4-Dichloro-2-butene	FL	4600	10184404
Dibromomethane (Methylene bromide)	FL	4595	10184404
Dichlorodifluoromethane (Freon-12)	FL	4625	10184404
Diethyl ether	FL	4725	10184404
Ethyl acetate	FL	4755	10184404
Ethyl methacrylate	FL	4810	10184404
Ethylbenzene	FL	4765	10184404
Hexachlorobutadiene	FL	4835	10184404
Iodomethane (Methyl iodide)	FL	4870	10184404
Isobutyl alcohol (2-Methyl-1-propanol)	FL	4875	10184404
Isopropyl alcohol (2-Propanol, Isopropanol)	FL	4895	10184404
Isopropylbenzene (Cumene)	FL	4900	10184404
Methacrylonitrile	FL	4925	10184404
Methyl bromide (Bromomethane)	FL	4950	10184404
Methyl chloride (Chloromethane)	FL	4960	10184404
Methyl methacrylate	FL	4990	10184404
Methyl tert-butyl ether (MTBE)	FL	5000	10184404

Matrix: ***Solid & Chemical Materials***

Methylene chloride (Dichloromethane)	FL	4975	10184404
Naphthalene	FL	5005	10184404
n-Butyl alcohol (1-Butanol, n-Butanol)	FL	4425	10184404
n-Butylbenzene	FL	4435	10184404
n-Propylbenzene	FL	5090	10184404
Pentachloroethane	FL	5035	10184404
Propionitrile (Ethyl cyanide)	FL	5080	10184404
sec-Butylbenzene	FL	4440	10184404
Styrene	FL	5100	10184404
tert-Butyl alcohol	FL	4420	10184404
tert-Butylbenzene	FL	4445	10184404
Tetrachloroethylene (Perchloroethylene)	FL	5115	10184404
Toluene	FL	5140	10184404
trans-1,2-Dichloroethylene	FL	4700	10184404
trans-1,3-Dichloropropylene	FL	4685	10184404
trans-1,4-Dichloro-2-butene	FL	4605	10184404
Trichloroethene (Trichloroethylene)	FL	5170	10184404
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	FL	5175	10184404
Vinyl acetate	FL	5225	10184404
Vinyl chloride	FL	5235	10184404
Xylene (total)	FL	5260	10184404

Method EPA 8270

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2,4,5-Tetrachlorobenzene	FL	6715	10185203
1,2,4-Trichlorobenzene	FL	5155	10185203
1,2-Dichlorobenzene	FL	4610	10185203
1,2-Diphenylhydrazine	FL	6220	10185203
1,3,5-Trinitrobenzene (1,3,5-TNB)	FL	6885	10185203
1,3-Dichlorobenzene	FL	4615	10185203
1,3-Dinitrobenzene (1,3-DNB)	FL	6160	10185203

Texas Commission on Environmental Quality

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Orlando, FL 32811-5803

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Matrix: ***Solid & Chemical Materials***

1,4-Dichlorobenzene	FL	4620	10185203
1,4-Naphthoquinone	FL	6420	10185203
1,4-Phenylenediamine	FL	6630	10185203
1-Chloronaphthalene	FL	5790	10185203
1-Naphthylamine	FL	6425	10185203
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	FL	4659	10185203
2,3,4,6-Tetrachlorophenol	FL	6735	10185203
2,4,5-Trichlorophenol	FL	6835	10185203
2,4,6-Trichlorophenol	FL	6840	10185203
2,4-Dichlorophenol	FL	6000	10185203
2,4-Dimethylphenol	FL	6130	10185203
2,4-Dinitrophenol	FL	6175	10185203
2,4-Dinitrotoluene (2,4-DNT)	FL	6185	10185203
2,6-Dichlorophenol	FL	6005	10185203
2,6-Dinitrotoluene (2,6-DNT)	FL	6190	10185203
2-Acetylaminofluorene	FL	5515	10185203
2-Chloronaphthalene	FL	5795	10185203
2-Chlorophenol	FL	5800	10185203
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	FL	6360	10185203
2-Methylaniline (o-Toluidine)	FL	5145	10185203
2-Methylnaphthalene	FL	6385	10185203
2-Methylphenol (o-Cresol)	FL	6400	10185203
2-Naphthylamine	FL	6430	10185203
2-Nitroaniline	FL	6460	10185203
2-Nitrophenol	FL	6490	10185203
2-Picoline (2-Methylpyridine)	FL	5050	10185203
3,3'-Dichlorobenzidine	FL	5945	10185203
3,3'-Dimethylbenzidine	FL	6120	10185203
3-Methylcholanthrene	FL	6355	10185203
3-Methylphenol (m-Cresol)	FL	6405	10185203

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Matrix: ***Solid & Chemical Materials***

3-Nitroaniline	FL	6465	10185203
4-Aminobiphenyl	FL	5540	10185203
4-Bromophenyl phenyl ether (BDE-3)	FL	5660	10185203
4-Chloro-3-methylphenol	FL	5700	10185203
4-Chloroaniline	FL	5745	10185203
4-Chlorophenyl phenylether	FL	5825	10185203
4-Dimethyl aminoazobenzene	FL	6105	10185203
4-Methylphenol (p-Cresol)	FL	6410	10185203
4-Nitroaniline	FL	6470	10185203
4-Nitrophenol	FL	6500	10185203
4-Nitroquinoline-1-oxide	FL	6510	10185203
5-Nitro-o-toluidine	FL	6570	10185203
7,12-Dimethylbenz(a) anthracene	FL	6115	10185203
a-a-Dimethylphenethylamine	FL	6125	10185203
Acenaphthene	FL	5500	10185203
Acenaphthylene	FL	5505	10185203
Acetophenone	FL	5510	10185203
Aniline	FL	5545	10185203
Anthracene	FL	5555	10185203
Aramite	FL	5560	10185203
Atrazine	FL	7065	10185203
Benzenethiol (Thiophenol)	FL	6750	10185203
Benzidine	FL	5595	10185203
Benzo(a)anthracene	FL	5575	10185203
Benzo(a)pyrene	FL	5580	10185203
Benzo(b)fluoranthene	FL	5585	10185203
Benzo(g,h,i)perylene	FL	5590	10185203
Benzo(k)fluoranthene	FL	5600	10185203
Benzoic acid	FL	5610	10185203
Benzyl alcohol	FL	5630	10185203

Matrix: ***Solid & Chemical Materials***

Biphenyl	FL	5640	10185203
bis(2-Chloroethoxy)methane	FL	5760	10185203
bis(2-Chloroethyl) ether	FL	5765	10185203
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	FL	6065	10185203
Butyl benzyl phthalate	FL	5670	10185203
Caprolactam	FL	7180	10185203
Carbazole	FL	5680	10185203
Chlorobenzilate	FL	7260	10185203
Chrysene	FL	5855	10185203
Diallate	FL	7405	10185203
Dibenz(a,h) anthracene	FL	5895	10185203
Dibenz(a,j) acridine	FL	5900	10185203
Dibenzofuran	FL	5905	10185203
Diethyl phthalate	FL	6070	10185203
Dimethoate	FL	7475	10185203
Dimethyl phthalate	FL	6135	10185203
Di-n-butyl phthalate	FL	5925	10185203
Di-n-octyl phthalate	FL	6200	10185203
Diphenylamine	FL	6205	10185203
Disulfoton	FL	8625	10185203
Ethyl methanesulfonate	FL	6260	10185203
Famphur	FL	7580	10185203
Fluoranthene	FL	6265	10185203
Fluorene	FL	6270	10185203
Hexachlorobenzene	FL	6275	10185203
Hexachlorobutadiene	FL	4835	10185203
Hexachlorocyclopentadiene	FL	6285	10185203
Hexachloroethane	FL	4840	10185203
Hexachlorophene	FL	6290	10185203
Hexachloropropene	FL	6295	10185203

Matrix: ***Solid & Chemical Materials***

Indeno(1,2,3-cd) pyrene	FL	6315	10185203
Isodrin	FL	7725	10185203
Isophorone	FL	6320	10185203
Isosafrole	FL	6325	10185203
Kepone	FL	7740	10185203
Methapyrilene	FL	6345	10185203
Methyl methanesulfonate	FL	6375	10185203
Methyl parathion (Parathion, methyl)	FL	7825	10185203
Naphthalene	FL	5005	10185203
Nitrobenzene	FL	5015	10185203
n-Nitrosodiethylamine	FL	6525	10185203
n-Nitrosodimethylamine	FL	6530	10185203
n-Nitrosodi-n-butylamine	FL	5025	10185203
n-Nitrosodi-n-propylamine	FL	6545	10185203
n-Nitrosodiphenylamine	FL	6535	10185203
n-Nitrosomethylethylamine	FL	6550	10185203
n-Nitrosomorpholine	FL	6555	10185203
n-Nitrosopiperidine	FL	6560	10185203
n-Nitrosopyrrolidine	FL	6565	10185203
o,o,o-Triethyl phosphorothioate	FL	8290	10185203
Parathion, ethyl	FL	7955	10185203
Pentachlorobenzene	FL	6590	10185203
Pentachloronitrobenzene (PCNB)	FL	6600	10185203
Pentachlorophenol	FL	6605	10185203
Phenacetin	FL	6610	10185203
Phenanthrene	FL	6615	10185203
Phenol	FL	6625	10185203
Phorate	FL	7985	10185203
Pronamide (Kerb)	FL	6650	10185203
Pyrene	FL	6665	10185203

Matrix: ***Solid & Chemical Materials***

Pyridine	FL	5095	10185203
Quinoline	FL	6670	10186002
Safrole	FL	6685	10185203
Sulfotepp	FL	8155	10185203
Thionazin (Zinophos)	FL	8235	10185203

Method EPA 8316

Analyte	**AB**	**Analyte ID**	**Method ID**
Acrylamide	FL	4330	10188202

Method EPA 8330

Analyte	**AB**	**Analyte ID**	**Method ID**
1,3,5-Trinitrobenzene (1,3,5-TNB)	FL	6885	10189807
1,3-Dinitrobenzene (1,3-DNB)	FL	6160	10189807
2,4,6-Trinitrotoluene (2,4,6-TNT)	FL	9651	10189807
2,4-Dinitrotoluene (2,4-DNT)	FL	6185	10189807
2,6-Dinitrotoluene (2,6-DNT)	FL	6190	10189807
2-Amino-4,6-dinitrotoluene (2-am-dnt)	FL	9303	10189807
2-Nitrotoluene	FL	9507	10189807
3-Nitrotoluene	FL	9510	10189807
4-Amino-2,6-dinitrotoluene (4-am-dnt)	FL	9306	10189807
4-Nitrotoluene	FL	9513	10189807
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	FL	6415	10189807
Nitrobenzene	FL	5015	10189807
Nitroglycerin	FL	6485	10189807
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	FL	9522	10189807
Pentaerythritoltetranitrate (PETN)	FL	9558	10189807
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	FL	9432	10189807

Method EPA 8332

Analyte	**AB**	**Analyte ID**	**Method ID**
Nitroglycerin	FL	6485	10190406

Method EPA 9012

Analyte	**AB**	**Analyte ID**	**Method ID**

Matrix: ***Solid & Chemical Materials***

Total cyanide	FL	1645	10193201

Method EPA 9045

Analyte	**AB**	**Analyte ID**	**Method ID**
pH	FL	1900	10197805

Method EPA 9056

Analyte	**AB**	**Analyte ID**	**Method ID**
Bromide	FL	1540	10199209
Chloride	FL	1575	10199209
Fluoride	FL	1730	10199209
Nitrate as N	FL	1810	10199209
Nitrate-nitrite	FL	1820	10199209
Nitrite as N	FL	1840	10199209
Sulfate	FL	2000	10199209

Method EPA 9060

Analyte	**AB**	**Analyte ID**	**Method ID**
Total Organic Carbon (TOC)	FL	2040	10200201

Method EPA 9071

Analyte	**AB**	**Analyte ID**	**Method ID**
n-Hexane Extractable Material (HEM) (O&G)	FL	1803	10201204
Silica Gel Treated n-Hexane Extractable Material (SGT-HEM)	FL	10220	10201204

Method IDNR OA-1; GRO

Analyte	**AB**	**Analyte ID**	**Method ID**
Volatile Petroleum Hydrocarbons (Gasoline)	FL	10330	90016403

Method IDNR OA-2; DRO

Analyte	**AB**	**Analyte ID**	**Method ID**
Extractable Petroleum Hydrocarbons (EPH)	FL	10331	90016607

Method Tennessee EPH

Analyte	**AB**	**Analyte ID**	**Method ID**
Total Petroleum Hydrocarbons (TPH)	FL	2050	Tennessee-EPH

Method Tennessee GRO

Analyte	**AB**	**Analyte ID**	**Method ID**

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Matrix: ***Solid & Chemical Materials***

Total Petroleum Hydrocarbons (TPH)	FL	2050	60053307

APPENDIX F

STANDARD OPERATING PROCEDURES

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APPENDIX F.4 LABORATORY SOPS

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APPENDIX F.1

MEC – STANDARD OPERATING PROCEDURES

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TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – ANOMALY AVOIDANCE

Page 1 of 10
SOP Number: 18-01-02
Effective Date: 10/05/2020

Technical Approval: ______________________________ Date: 10/5/2020

QA Management Approval: David E. Dobb ______________________ Date: 10/5/2020

SOP Description

The purpose of this standard operating procedure (SOP) is to provide procedures for persons conducting munitions and explosives of concern (MEC) anomaly avoidance duties at Department of Defense (DoD) Munitions Response Sites (MRSs) where MEC operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Pan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)].

Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held instrument will be used) will be documented in the project/site-specific plans.

In the event that MEC is encountered during MEC anomaly avoidance activities, the item will be guarded until disposal operations can be conducted and the Project Manager will be notified. Whether TLI Solutions (TLI) personnel, subcontractors, or DoD Explosive Ordnance Disposal assets respond to MEC discoveries will be determined by the project/site-specific plans. Where TLI's scope of work includes explosive operations and MEC disposal, TLI will be responsible for providing the qualified personnel necessary to perform MEC disposal per *MEC SOP 18-04-XX, Explosive Demolition for Disposal of Munitions* and an approved ESP or ESS. Implementation of this SOP may also require potential implementation of MEC SOP 18-05-XX, *Explosives Management* and MEC SOP 18-06-XX, *MPPEH and Other Debris Management*.

This SOP and MEC anomaly avoidance activities are to be implemented consistent with the requirements of:

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics,* December 2016.
- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities,* June 2020.

- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.
- USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.
- USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

- Hand-held geophysical instrument (e.g., Schonstedt, White's, or other hand-held geophysical survey instruments)
- Differential Global Positioning System (DGPS)
- Fiberglass shaft pin flags (as required)
- Brightly colored surveyors tape (as required)
- High visibility, biodegradable spray paint (as required)
- Logbook and/or field forms (as required)
- Camera (as required)

Personnel Requirements

For anomaly avoidance on a site with known or suspected MEC, an unexploded ordnance (UXO) team consisting of a minimum of two personnel, one of whom must be a UXO Technician II, will be provided as an escort (UXO Escort). The UXO Technician II will be the UXO team leader. The UXO team must be on-site during all activities requiring MEC avoidance/escort duties. The UXO team may include additional UXO-qualified personnel, geophysicists, or any other team member, depending on site- and task-specific conditions/requirements. Any government personnel on-site will either fall under the purview of the contractor UXO Escort or be responsible for providing their own UXO Escort.

Roles and Responsibilities

The UXO Escort will have the following responsibilities for anomaly avoidance procedures during an environmental investigation or construction support project on a site with known or suspected MEC:

- Provide MEC recognition, location, and explosives safety functions.
- Conduct explosives safety briefings for all site personnel and visitors.
- Initiate MEC reporting procedures in accordance with the approved project/site-specific plans.

Prior to entering an area requiring MEC avoidance, the UXO Escort must conduct a tailgate safety briefing. This briefing will cover emergency procedures, operations, and ordnance avoidance procedures with all site personnel being escorted.

Equipment Quality Control (QC) Checks

Hand-held geophysical survey instruments QC checks, as described below, are to be performed on a daily basis (if the instrument is to be used that day). All hand-held detector equipment QC checks will be recorded and documented.

Battery Check

When turning on the detector, the operator will perform a battery check per manufacturer's instructions. It is recommended to frequently replace the batteries.

Personnel Test

The operator will perform personnel tests to determine whether any metal on his or her person (clothing, jewelry, metallic components of boots/shoes, etc.) affects detector response. The operator will swing the detector well away from the body (as when performing production survey), move the swinging motion and detector closer to the body and over the feet, and observe and listen for any change in instrument response. The operator will remove and/or replace personal items interfering with instrument response. The operator will record daily personnel tests as well as instances where tests were failed and corrective actions were taken.

Site Access Survey

The UXO Escort must conduct a surface access survey and a subsurface survey for anomalies (if intrusive activities are planned) before any type of activities commence, including foot and vehicular traffic.

All personnel must be escorted by UXO-qualified personnel at all times in areas potentially containing MEC until the UXO Escort has completed the access surveys and the cleared areas have been marked. Escorted personnel will follow behind the UXO Escort. In the event that MEC is encountered during MEC anomaly avoidance activities, the item will be guarded until disposal operations can be conducted.

The UXO Escort will conduct an access survey of the footpath and/or vehicular lanes approaching and leaving sampling/work areas with known or suspected MEC. Typically, the access route will be at least twice as wide as the widest vehicle that will use the route.

The UXO Escort must also complete an access survey of an area around the proposed investigation/work site that is large enough to support all planned operations. The size of the surveyed area will be site-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment, etc.), parking of support vehicles, and establishment of decontamination stations. At a minimum, the surveyed area will have a dimension in all directions equal to twice the length of the longest vehicle or piece of equipment to be brought on-site.

Geophysical instrumentation capable of detecting the smallest known or anticipated MEC item will be used to locate anomalies just below the surface that may be encountered through erosion from rain or continual vehicular traffic.

If anomalies or surface MEC are encountered, they will be marked with flagging, and the investigation/work area will be relocated to avoid contact. The UXO Escort will clearly mark the boundaries of the surveyed area using survey flagging and pin flags. The UXO Escort will establish a system of flagging colors that will distinguish anomalies, surface MEC, and route boundaries from each other as well as from any utility markings that have been used at the site.

No personnel will be allowed outside the surveyed areas without a UXO Escort.

Surface Soil Sampling

Surface soil samples are normally collected at depths from 0 to 6 inches below ground surface. The following paragraphs describe anomaly avoidance procedures for soil sampling between 0 and 6 inches below ground surface on a site with known or suspected MEC. Soil sampling at depths greater than 6 inches below ground surface on a site with known or suspected MEC will follow the procedures discussed below in the "Subsurface Soil Sampling" section. The UXO Escort must conduct an access survey of the routes to and from the proposed sampling site as well as an area around the investigation site, as described above in the "Access Survey" section.

The UXO Escort must visually survey the surface of each proposed surface soil sampling site for any indication of MEC or Munitions Constituent (MC) impact. In addition, the UXO Escort must conduct a survey of the proposed sampling locations using geophysical instruments capable of detecting the smallest known or anticipated MEC item to a depth of 1 foot.

If anomalies are detected at a proposed sampling location or too many anomalies are detected in a general area of interest, the sampling personnel will select an alternate location for collection of surface soil samples. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance during sampling activities.

Passive Soil Gas Sampling

Passive soil gas sampling typically involves excavation of holes (1-inch to 1½-inches in diameter) to a depth of less than 5 feet and the installation and subsequent removal of sampling devices (typically 24-inch-long by ½-inch-inside-diameter tubes). The following paragraphs describe anomaly avoidance procedures for passive soil gas sampling on a site with known or suspected MEC. The UXO Escort must conduct an access survey of the routes to and from the proposed sampling site as well as an area around the investigation site, as described above in the "Access Survey" section.

The UXO Escort must visually survey the surface of the proposed passive soil gas sampling sites for any indication of MEC or MC impact. In addition, the UXO Escort must conduct a survey of the proposed sampling locations using geophysical instruments capable of detecting the smallest known or anticipated MEC item to the specified emplacement depth for the sampling canister.

If the emplacement depth is greater than the geophysical instrument's detection capabilities, then the UXO Escort must incrementally complete the geophysical survey every 12 inches while excavating for emplacement of the sampling canisters. While the UXO escort is completing the geophysical survey, remaining project personnel must withdraw out of the immediate area (unless they are deemed as essential personnel and an exception is made for the project).

If anomalies are detected at a proposed sampling location or too many anomalies are detected in a general area of interest, the sampling personnel will select an alternate location for collection of passive soil gas samples. If an anomaly is detected during an incremental geophysical survey, the hole will be backfilled in accordance with site-specific procedures. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance.

Unless a path is clearly marked, the sampling personnel must be escorted by a UXO-qualified person when they subsequently return to each soil gas sampling site to retrieve the sampling canisters.

Active Soil Gas Sampling and Direct Push Technology

Active soil gas sampling typically involves manual or mechanical penetration at the desired location followed by withdrawal and collection of a soil gas sample. Direct Push Technology (DPT) is a common method for mechanical penetration during active soil gas sampling and monitoring well installation. The following paragraphs describe anomaly avoidance procedures for active soil gas sampling and use of DPT on a site with known or suspected MEC. The UXO Escort must conduct an access survey of the routes to and from the proposed sampling site as well as an area around the investigation site, as described above in the "Access Survey" section.

Active Soil Gas Sampling and DPT installations will follow the same anomaly avoidance procedures outlined below for soil boring and monitoring well installations. The actual sampling will occur through the pilot hole or a boring located within a 2-foot radius of the pilot hole installed by the UXO Escort. If the pilot hole cannot be used to obtain a representative soil gas sample, it must be backfilled in accordance with site-specific procedures prior to the installation and sampling of the soil gas sampling point. The backfilling of the pilot hole will be performed to prevent the soil gas sampling from being diluted by atmospheric air that may be drawn in through the pilot hole. Following collection of the soil gas sample, the sampling location must be backfilled in accordance with site specific procedures.

Subsurface Soil Sampling and Monitoring Well Installation

Subsurface soil sampling is defined as the collection of samples below a nominal depth of approximately 6 inches by means of a split-spoon, Shelby tube, or bucket auger soil sampler using drilling techniques. Drilling techniques are also used to install groundwater monitoring wells for investigative sampling. The following paragraphs describe anomaly avoidance procedures for subsurface soil sampling and monitoring well installations on a site with known or suspected MEC. The UXO Escort must conduct an access survey of the routes to and from the proposed sampling site as well as an area around the investigation site, as described above in the "Access Survey" section.

Sampling and Well Site Survey

The UXO Escort must complete a subsurface geophysical survey of the proposed drill hole location(s). If an anomaly is detected, the sampling personnel must select a new drill hole location. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance. If the subsurface sampling or well installation depth is greater than the geophysical instrument's detection capabilities, the UXO Escort must incrementally complete the geophysical survey as outlined below.

Pilot Hole/Incremental Geophysical Survey

Once an access survey has been completed, the UXO Escort will install a pilot hole at each proposed drill hole location. While the UXO Escort is completing their geophysical survey, remaining project personnel must withdraw out of the immediate area.

If an anomaly is detected, the pilot hole will be backfilled in accordance with site-specific procedures, and sampling personnel must select a new drill hole location. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance. If an anomaly is detected during an incremental geophysical survey, the hole will be backfilled in accordance with site-specific procedures. Any anomalies detected will be prominently marked with survey flagging or pin flags for avoidance.

As long as no anomalies are detected, the pilot hole will be advanced to a depth of 4 feet below ground surface. During the excavation of the pilot hole, the drill rig's auger will be withdrawn and the hole checked for anomalies every 12 inches. The pilot hole will also be inspected upon reaching the final depth, providing a total clearance depth equal to the pilot hole depth plus 12 inches. If no anomalies are detected to the total depth of the proposed drill hole, the drill rig may be brought on-site and utilized.

In cases where the pilot hole does not reach 4 feet below ground surface (e.g., the UXO Escort cannot penetrate the soils using the auger), the drill rig may be brought on-site and advanced in 12-inch increments beyond the clearance depth of the pilot hole. At the end of each 12-inch increment, the drill rig's auger must be withdrawn from the hole so that the UXO Escort may screen for anomalies as described above. As necessary with loose soils, a polyvinyl chloride (PVC) pipe (minimum 3 inches inner diameter) will be inserted to keep the hole open and to allow for incremental geophysical screening.

Monitoring of Drilling by Others

Once the UXO Escort determines that a proposed drill hole location is free of anomalies, using the procedures described above, the drilling contractor can commence subsurface sampling or monitoring well installation.

The drilling contractor's actual drill hole must be located within a 2-foot radius of the pilot hole installed by the UXO Escort. While this proximity to the pilot hole may affect the accuracy of "blow counts" for the sampling team, anomaly avoidance takes precedence.

In order to avoid magnetic interference from the augers, the drill rig must withdraw its augers from the hole for the geophysical survey. As necessary with loose soils, a PVC pipe (minimum 3 inches inner diameter) may be inserted to keep the hole open and to allow for incremental geophysical screening. Drilling equipment and/or metallic support materials (e.g., drill rig, augers, drill rods, casings, etc.) may create an interference affecting the operation of the geophysical survey instrument during the incremental inspection process. In such an event, the item(s) creating the interference must be relocated outside the interference range of the geophysical instrument during each incremental inspection of the drill hole. If an anomaly is detected, the drill hole will be backfilled in accordance with site-specific procedures, and the sampling personnel must select a new drill hole location.

Health and Safety

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

It is TLI's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress that is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed boots, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan [i.e., Abbreviated Accident Prevention Plan (AAPP) or APP/SSHP] for detailed health and safety procedures. This plan must be reviewed prior to beginning work.

QA/QC

Typically, QA/QC is not focused on MEC anomaly avoidance but on the work activities being escorted (e.g., soil sampling, monitoring well installation, etc.). However, the hand-held geophysical survey instruments used shall be operated and maintained per manufacturer's instructions and QC checks performed as discussed above.

Comments/Notes

None at this time.

References

Department of Army, Pamphlet 385-64, *Ammunition and Explosives Safety Standards*, October 2013.

DDESB, TP 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

USACE, EM 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.

USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.

USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

RECORD OF CHANGES/REVIEW

Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
18-01-00	2/12/2018	Entirely rewritten from all prior versions
18-01-01	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents.
18-01-02	10/5/2020	Reviewed for accuracy, minor changes made in SOP Descriptions and References sections – updated references to latest available documents. Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – SURFACE CLEARANCE OPERATIONS

Page 1 of 13
SOP Number: 18-02-02
Effective Date: 10/5/2020

Technical Approval: ______________________________ Date: 10/5/2020

QA Management Approval: David E. Dobb ______________________________ Date: 10/5/2020

SOP Description

The purpose of this standard operating procedure (SOP) is to provide procedures for the surface clearance of Munitions and Explosives of Concern (MEC), material potentially presenting an explosive hazard (MPPEH), and metallic non-munitions related debris (NMRD) from the surface of the ground at Department of Defense (DoD) Munitions Response Sites (MRS) where MEC operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Pan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)].

This SOP is not intended to contain all project/site-specific requirements but must be used in conjunction with the applicable, approved project/site-specific plans and Federal, state, and local regulations. Consult the documents listed in the reference section of this SOP for additional compliance issues. Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held instrument will be used) will be documented in individual project/site-specific plans. These procedures may be refined with the concurrence of the project team to adapt to specific site conditions and circumstances. Any refinements, changes and/or additions to the procedures of the SOP must be documented and approved according to project-specific requirements.

The approved project/site-specific plans must define the objectives for the surface clearance including:

- Purpose for the clearance (e.g., to improve conditions for subsurface geophysical survey, improve surface conditions prior to corrective measures implementation, as the chief means of implementing a selected corrective measure calling for a surface clearance, etc.).
- Acceptability criteria (e.g., judged by quality management personnel and/or geophysicist as acceptable for subsequent geophysical survey as acceptable, all visible metallic anomalies greater than a certain size, etc.)

- Quality Control (QC) process potentially including inspection, blind seeding, and/or other QC measures.

Implementation of this SOP also requires potential implementation of MEC SOP 18-04-XX, *Explosive Demolition for Disposal of Munitions*; MEC SOP 18-05-XX, *Explosives Management*; and MEC SOP 18-06-XX, *MPPEH and Other Debris Management*.

This SOP and MEC surface clearance activities are to be implemented consistent with the requirements of:

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.
- DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.
- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions* (USACE, 2018).
- USACE, EM 385-1-1, *Safety and Health Requirements*, (USACE, 2014).
- USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures

08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

- Hand-held geophysical instrument (e.g., Schonstedt, White’s, or other hand-held geophysical survey instruments)
- Differential Global Positioning System (DGPS)
- Tape measures
- Ropes
- 5-gallon buckets
- 55-gallon drums and/or lockable roll-off containers (as required)
- Fiberglass shaft pin flags (as required)
- Brightly colored surveyor’s tape (as required)
- High visibility, biodegradable spray paint (as required)
- Logbook and/or field forms (as required)
- Camera (as required)

Roles and Responsibilities

Unexploded Ordnance (UXO) Qualified Personnel (UXOQP)

These personnel conduct, manage, or oversee MEC-related activities (e.g., reacquire and investigate anomalies, document explosives safety status of materials) required during munitions responses and operational range clearance activities and/or verify the completion of such responses and activities safely and per applicable requirements and approved plans. UXOQP will meet or exceed the requirements for their respective positions as presented in DDESB TP 18 (DDESB, 2020).

Senior UXO Supervisor (SUXOS)

The SUXOS will be the senior subject matter expert in the field during the execution of this surface removal. The SUXOS's responsibilities include:

- Primary Point of Contact (POC) with the on-site client team and project team.
- Planning, coordinating, and supervising on-site MEC-related activities.
- Coordinating and supervising on-site subcontractors.
- Implementing procedures and guidance for MEC operations (ensuring compliance with DoD directives and Federal, state, and local statutes and codes).
- Inspecting and certifying MPPEH to reclassify as Material Documented as Safe (MDAS) for safe turn-in or disposal.
- Preparing a daily report.
- Adherence to the contract schedule.

The SUXOS will report directly to the Project Manager (PM) and will have an open line of communication with the UXO Quality Control Specialist (UXOQCS) and UXO Safety Officer (UXOSO).

UXOSO

The UXOSO will be the single POC for on-site safety issues and will implement the APP/SSHP, (inclusive of the MEC and hazardous, toxic, and radioactive waste components) and will verify compliance with applicable safety and health requirements. The UXOSO will be responsible for monitoring compliance with plans, procedures, and regulations relative to the health and safety of employees, project members, land users, residents, and visitors during all site activities.

The UXOSO maintains a line of communication with the PM, SUXOS, and UXOQCS for project-specific direction and will report directly within the TLI Solutions (TLI) program safety chain for administrative and technical direction on health and safety matters.

The UXOSO will implement the approved project/site-specific plans and the safety program in compliance with DoD, Federal, state, and local statutes and codes; analyze UXO and explosives operational risks, hazards, and safety requirements; establish and ensure compliance with site-specific safety requirements for UXO and explosives operations; enforce personnel limits and safety exclusion zones (EZs) for UXO and explosives operations, UXO and explosives transportation, storage, and destruction; and conduct safety inspections to ensure compliance with UXO and explosives safety codes. The UXOSO has authority to temporarily stop work to correct an unsafe condition or procedure.

The UXOSO is to be physically on-site whenever project-related fieldwork is in progress.

UXOQCS

The UXOQCS will be the single POC for on-site quality issues. The UXOQCS will be responsible for monitoring site activities for compliance with plans, procedures, and regulations relative to quality in meeting the project statement of objectives. The UXOQCS is additionally responsible for:

- Monitoring activities affecting quality during the surface clearance operations.
- Ensuring that procedures are being carried out in accordance with established requirements and protocols.
- Performing QC activities per the approved project/site-specific plan, specifically the QAPP.
- Preparing the Daily Quality Control Report (DQCR).

The UXOQCS position may be combined with UXOSO when there are 15 or fewer people on-site. The UXOSO or UXOQCS/UXOSO will not be involved in any MEC removal or investigation tasks.

The UXOQCS maintains a line of communication with the PM, SUXOS, and UXOSO for project-specific direction and will report directly within the TLI program quality management chain for administrative and technical direction on quality management matters.

UXO Technician III (UXO T-III)

The UXO T-III supervises a UXO team performing surface clearance operations. The UXO T-III may also serve in the capacity of Demolition Supervisor during demolition and explosives demilitarization operations (MEC SOP 18-04-XX4). The UXO T-III is responsible for:

- Supervising the team to which he/she is assigned.
- Providing MEC subject matter expertise to ensure the team’s safety and the project’s quality.
- Ensuring the team’s action is accomplished safely and efficiently.
- Maintaining administrative records related to the team’s operations.
- Implementing the project/site-specific work, safety, and quality plans.

- Being familiar with the duties of all assigned personnel and being able to perform all of the functions enumerated for UXO Technicians I and II (UXO T-I and T-II).

UXO UXO T-II

The UXO T-II is the primary MEC worker on the site and performs as part of the team to locate, visually identify, remove, and dispose of MEC, munitions debris (MD), MPPEH, and NMRD. The UXO technicians assist in documenting information related to the team’s activities. The UXO T-II will report directly to the UXO T-III and will have the experience/qualifications and be able to perform the functions required in DDESB TP 18 (DDESB, 2020).

UXO T-I

The UXO T-I is the secondary MEC worker on the site and performs as part of the team to locate, remove, and dispose of MEC, MD, MPPEH, and NMRD. The UXO T-I will report directly to the UXO T-III and will have the experience/qualifications and be able to perform the functions required in DDESB TP 18 (DDESB, 2020).

Unexploded Ordnance Sweep Personnel (UXOSP)

UXOSP assist UXO technicians and UXOQP in the performance of UXO-related activities (e.g., visual and/or detector-aided surficial survey, marking anomalies/suspect items, removal and management of items that have received an initial inspection by a UXOQP who determined the risk of movement is acceptable). UXOSP do not have to be a UXO Technician; however, they shall be provided job and site-specific training. This training is identified in DDESB TP 18 (DDESB, 2020). UXOSP are not involved in the execution of explosives operations (not involved in activities that result in physical contact with MEC).

EZs and Authorized Personnel

EZ

An EZ is a safety zone established around an MEC-related operation work area. Only essential project personnel and authorized, escorted visitors are allowed within the exclusion zone.

The size of the EZs applicable to the planned work will be identified in the project/site-specific ESP/ESS and will be based on the greater of either the Munitions with the

Greatest Fragmentation Distance (MGFD) or munitions with the greatest overpressure distance.

If MEC with a greater fragmentation/overpressure distance than the MGFD/munition with greatest overpressure distance is encountered, the EZs will be adjusted in accordance with DDESB Technical Paper 16, operations will continue, and an amendment to the ESP/ESS will be submitted for approval (a copy of this document will be available on site). EZs will be adjusted accordingly.

EZs will be established and marked with clearly identifiable markers such as traffic cones or delineators, sandwich boards, etc. Any required signs will be placed at the entrance to the site or other ingress/egress points associated with the site.

Essential Personnel

Personnel authorized to work within the EZ are defined as Essential Personnel. Essential Personnel are USACE project personnel necessary for the safe and efficient completion of field operations conducted in an EZ. This is limited to: TLI work team members including the UXOSO, UXOQCS, SUXOS, and a USACE Ordnance and Explosive Safety Specialist (OESS).

Essential Personnel will maintain the minimum Team Separation Distance (TSD), as identified in the ESP/ESS, from other teams working in the area. This includes the UXO teams.

Visitors

Authorized Visitors are defined as DoD, Army, USACE, or other personnel conducting project-related functions, such as Quality Assurance Representatives (QARs), safety and quality inspectors, and project management. Authorized visitors must be escorted while in the EZ and be approved for entry into the EZ per this SOP and EM 385-1-97. No more than two authorized visitors will be permitted in the EZ at any given time.

Persons requesting access to the EZ must demonstrate a legitimate need for access and obtain authorization from the PM and UXOSO and must submit their access request prior to the site visit.

Prior to entry, visitors must receive a site-specific briefing describing the specific hazards and safety procedures to follow and must acknowledge the receipt of the briefing in writing.

Any authorized visitor who violates established safety procedures will be immediately escorted out of the EZ for the visitor's own protection and to protect essential personnel in the EZ.

TSDs

TSD is the distance that essential personnel must be separated by during the conduct of MEC activities on a MEC site. The TSD between UXO teams for the project will be specified in the approved ESP/ESS. This value will be calculated and reviewed for each area if munitions with greater MGFDs are discovered to ensure proper and safe separation of teams.

Tasks not necessary to the operation will be prohibited within the immediate area of the hazard produced by the operation. Multi-discipline and multiple MEC project teams performing tasks required to execute the munitions response may be in the EZ while MEC procedures are being performed as long as TSDs are maintained. This must be coordinated with the UXOSO and OESS, if applicable.

Team Composition

UXO surface clearance teams will consist of one UXO T-III, one UXO T-II, and up to six UXOSPs (for a total of eight personnel). If the area to be cleared is large, two additional UXO T-IIs and up to 12 UXOSPs may be added to basic team (for a total of 22 personnel).

Equipment Quality Control (QC) Checks

Hand-Held Detector

All hand-held geophysical survey instruments must be inspected and verified to be functional prior to use by site personnel. Detection equipment/instruments that are new, spare, or requiring repair must be inventoried, inspected, and verified to be functional prior to use.

Equipment QC Checks

Hand-held detector equipment QC checks, as described below, are to be performed on a daily basis (if the instrument is to be used that day) regardless of what activity the instrument will support (survey, escort, etc.). All hand-held detector equipment QC checks will be recorded and documented.

Battery Check

When turning on the detector, the operator will perform a battery check per the manufacturer’s instructions. It is recommended to frequently replace the batteries.

Personnel Test

The operator will perform personnel tests to determine whether any metal on his or her person (clothing, jewelry, metallic components of boots/shoes, etc.) affects detector response. The operator will swing the detector well away from the body (as when performing production survey), move the swinging motion and detector closer to the body and over the feet, and observe and listen for any change in instrument response. The operator will remove and/or replace personal items interfering with instrument response. The operator will record daily personnel tests as well as instances where tests were failed and corrective actions were taken.

Boundaries and Survey Lanes

Prior to beginning the surface clearance and after any needed vegetation removal has been completed per the project/site-specific plans, the boundaries of the work area will be staked or marked to provide navigational guidance for the team performing the clearance. Methodology for identifying the clearance area (e.g., grid number or unique identifier for each clearance area) will be detailed in the project/site-specific plans and may be based on an established grid system, pre-planned transect lanes of a specified width, or areas delineated during the field effort. Personnel establishing boundary survey or control points will be accompanied by a minimum of a UXO T-II to provide MEC avoidance escort in accordance with MEC SOP 18-01-XX, *Munitions and Explosives of Concern Avoidance*.

Surface Clearance

Surface clearance operations consist primarily of detecting surface anomalies visually and are assisted as necessary by geophysical detection (using simple hand-held instruments). The surface clearance will proceed in the following manner:

1. Locate the boundary survey points of the area to be cleared. Establish “search lanes” with ropes or similar method to ensure 100% coverage of the proposed work area. The project/site-specific plan will specify the search lane width for the clearance.
2. Search lanes should be oriented in a direction that provides the best metallic anomaly response to instrument detection and noted in field documentation.

3. The UXO Team may establish search lanes with ropes or by a similar method in only a portion of the clearance area at any given time, but no rope (other than a rope delineating the perimeter of the clearance area) shall be removed until the lanes on each side have been surveyed. The rope or equivalent method must be in place to ensure 100% coverage of the clearance area.

4. UXO technicians will walk each search lane making a single pass. UXO technicians will walk forward slowly taking normal strides.

   - Radios shall not be used within the minimum safe distance (MSD) from MEC as specified in Department of the Army (DA) Pamphlet (PAM) 385-64, Section 3, paragraph 17-15.g (e.g., the MSD of 5 feet is prescribed for citizens band radios or walkie-talkies). Cell phones shall not be used within the vicinity of suspect ordnance items (EM 385-1-97).
   - The primary inspection method is visual observation.
   - Search lanes will be completed in the above manner until the entire grid or work area has been surveyed.
   - Visible anomalies (or partially visible) will be removed per project/site-specific plan specifications.
   - Evaluate each anomaly by carefully removing all surface debris at the anomaly location.
   - Once visible, a UXOQP will determine if the item is MEC. If the UXOQP is unable to determine the MEC/MPPEH item's identification, the SUXOS and UXOSO will be notified immediately to make the determination.
   - If a MEC/MPPEH item is positively identified by UXOQP, the SUXOS and UXOSO will be notified immediately upon discovery.
   - All MD and NMRD will be segregated and managed separately from MEC/MPPEH.
   - The UXO T-III/Team Leader (TL) will inform the SUXOS when surface clearance activities are completed. At the end of each day, the TL will complete any remaining documentation activities. The completed documentation will be submitted to the SUXOS for review and, if necessary, correction. The documentation will then be placed in the project files (physical and/or electronic) on-site.

5. The following guidelines pertain to the discovery of MEC/MPPEH on the surface:

- The SUXOS and UXOSO will make the determination of whether or not any item of MEC/MPPEH is acceptable to move.
- MEC/MPPEH that is not safe to move will be left in place and blown-in-place (BIP). The surface of the immediate area will be re-checked following the BIP to ensure the objectives of the surface clearance have been met.
- MEC/MPPEH that is safe to move will be removed and relocated to a consolidation point on-site for disposal. The surface of the consolidation/disposal area will be re-checked following disposal operations to ensure the objectives of the surface clearance have been met.
- In the event that MEC is encountered, the item will be guarded until disposal operations can be conducted.

Any alteration to these surface clearance procedures must be documented in an approved project/site-specific plan.

MEC/MPPEH, MD, and NMRD removed during surface clearance operations will be inspected and disposed of using the procedures outlined in MEC SOP 18-04-XX, *Explosive Demolition for the Disposal of Munitions*; MEC SOP 18-05-XX, *Explosive Management Plan*; and MEC SOP 18-06-XX, *MPPEH and Other Debris Management.*

The UXO T-III/TL will be primarily responsible for documenting surface clearance operations for the UXO team per the requirements and methodology detailed in the project/site-specific plan. The UXO T-III/TL shall also ensure photographic documentation of all MEC items and representative photographs of MD and other recovered items.

Communications

Site operations will not be conducted unless on-site communications are available. On-site communications may be accomplished either through the use of field radios and/or cell phone service. If cell phone service is not available, all site personnel must be aware of the location of the closest telephone or have direct radio communications to someone with telephone service available. If used, radios capable of communicating with the project field office or support zone (or site safety representative if field office not established for the project) will be located in each vehicle or taken with teams on foot.

Visual and/or radio communication between personnel in the support zone and personnel in the EZ will be maintained at all times.

The horns of vehicles or air horns, which are provided in each vehicle and EZ, will be used as a backup emergency notification system. The following horn signals will be used to communicate with personnel if the radio is not operable:

- One long blast – “Evacuate the Area”;
- Two short blasts – “All Clear”; and
- Three short blasts – “Emergency Help Required”.

The location of assembly points, emergency evacuation points, emergency routes, and other contents of the APP/SSHP will be discussed as necessary during the tailgate safety meetings. Copies of the APP/SSHP will be maintained in the field office, if applicable, and site vehicles.

Weather and Environmental Considerations

Prior to commencing operations and at periods throughout the day, the SUXOS will obtain local weather reports from radio, internet, or other services. Surface clearance operations will not be conducted if electrical storms are within 10 miles (as detected by a storm and lightning detector) of the clearance/disposal area or during severe weather conditions that would impact safety, such as winds exceeding 45 mph (as detected by a pocket weather meter). Additional weather and environmental considerations will be provided in the approved APP/SSHP.

Health and Safety

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

It is TLI’s policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress that is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed boots, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan (i.e., APP/SSHP) for detailed health and safety procedures. This plan must be reviewed prior to beginning work.

QA/QC

QC for surface clearance operations will be detailed in the project/site-specific plans, specifically the QAPP. However, the hand-held geophysical survey instruments used shall be operated and maintained per manufacturer’s instructions and QC checks performed as discussed above.

Comments/Notes

None at this time.

References

Department of Army, Pamphlet 385-64, *Ammunition and Explosives Safety Standards*, October 2013.

DDESB, TP 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

USACE, EM 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.

USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.

USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

RECORD OF CHANGES/REVIEW		
Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
18-02-00	2/12/2018	Entirely rewritten from all prior versions
18-02-01	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents. Throughout document – changed "other debris to non-munitions related debris (NMRD).
18-02-02	10/5/2020	Reviewed for accuracy, minor changes made in SOP Descriptions and References sections – updated references to latest available documents. Changed (DDESB, 2016) to (DDESB, 2020). Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – INTRUSIVE INVESTIGATION OPERATIONS

Page 1 of 16
SOP Number: 18-03-03
Effective Date: 11/30/2020

Technical Approval: ______________________ Date: 11/30/2020

QA Management Approval. David E. Dobb ______________________ Date: 11/30/2020

SOP Description

The purpose of this standard operating procedure (SOP) is to provide procedural guidance for intrusive investigation of subsurface anomalies during munitions response actions at Department of Defense (DoD) Munitions Response Sites (MRSs) where Munitions and Explosives of Concern (MEC) operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Pan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)]. These procedures cover intrusive investigation of both the “mag and dig” technique and reacquired anomalies targeted through digital geophysical mapping (DGM).

This SOP is not intended to contain all project/site-specific requirements but must be used in conjunction with the applicable, approved project/site-specific plans and Federal, state, and local regulations. Consult the documents listed in the reference section of this SOP for additional compliance issues. Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held instrument will be used) will be documented in individual project/site-specific plans. These procedures may be refined with the concurrence of the project team to adapt to specific site conditions and circumstances. Any refinements, changes, and/or additions to the procedures of the SOP must be documented and approved according to project-specific requirements.

The approved project/site-specific plans must define the objectives for the intrusive investigation including:

- Purpose for the investigation (e.g., to define the nature and extent of potential MEC, as the chief means of implementing a selected corrective measure calling for a subsurface clearance, etc.).
- Acceptability criteria (e.g., judged by quality management personnel and/or geophysicist as acceptable for land use, all target anomalies selected from the geophysical survey).

- Quality Control (QC) process potentially including inspection, blind seeding, and/or other QC measures.

Implementation of this SOP also requires potential implementation of MEC SOP 18-04-XX, *Explosive Demolition for Disposal of Munitions*; MEC SOP 18-05-XX, *Explosives Management*; and MEC SOP 18-06-XX, *MPPEH and Other Debris Management*.

This SOP and MEC intrusive investigation activities are to be implemented consistent with the requirements of:

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.
- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.
- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.
- USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.
- USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
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08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
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12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

At a minimum, the following equipment is applicable to intrusive investigation operations:

- Hand-held geophysical instrument (Schonstedt, White’s, or other hand-held geophysical instruments)
- Differential Global Positioning System (DGPS)
- Transport vehicles (trucks, All-Terrain Vehicles (ATVs), etc.)
- Communication radios (two-way)
- Hand tools (shovels, rakes, breaker-bar, etc.)
- Tape measures
- Ropes
- 5-gallon buckets
- 55-gallon drums and/or lockable roll-off containers (as required)
- Fiberglass shaft pin flags (as required)
- Brightly colored surveyor’s tape (as required)
- High visibility, biodegradable spray paint (as required)
- Logbook and/or field forms (as required)

- Camera (as required)
- Video Recorder (as required for visual observations of analog geophysics)
- Personnel GPS trackers (as required for velocity measurement of analog geophysics)
- Geonics EM61 MK2 electromagnetic all metal detector or other DGM equipment (as required)

Roles and Responsibilities

Unexploded Ordnance (UXO) Qualified Personnel (UXOQP)

These personnel conduct, manage, or oversee MEC-related activities (e.g., reacquire and investigate anomalies, document explosives safety status of materials) required during munitions responses and operational range clearance activities and/or verify the completion of such responses and activities safely and per applicable requirements and approved plans. UXOQP will meet or exceed the requirements for their respective positions as presented in the DDESB-approved "Minimum Qualification Standards" found in TP 18 – *Minimum Qualifications for UXO Technicians and Personnel*. (DDESB, 2020).

Senior UXO Supervisor (SUXOS)

The SUXOS will be the senior subject matter expert in the field during the execution of this surface removal. The SUXOS's responsibilities include:

- Primary Point of Contact (POC) with the on-site client team and project team.
- Planning, coordinating, and supervising on-site MEC-related activities.
- Coordinating and supervising on-site subcontractors.
- Implementing procedures and guidance for MEC operations (ensuring compliance with DoD directives and Federal, state, and local statutes and codes).
- Inspecting and certifying materials potentially presenting an explosive hazard (MPPEH) to reclassify as Material Documented as Safe (MDAS) for safe turn-in or disposal.
- Preparing a daily report.
- Adherence to the contract schedule.

The SUXOS will report directly to the Project Manager (PM) and will have an open line of communication with the UXO Quality Control Specialist (UXOQCS) and UXO Safety Officer

(UXOSO).

UXOSO

The UXOSO will be the single POC for on-site safety issues and will implement the APP/SSHP (inclusive of the MEC and hazardous, toxic, and radioactive waste components) and will verify compliance with applicable safety and health requirements. The UXOSO will be responsible for monitoring compliance with plans, procedures, and regulations relative to the health and safety of employees, project members, land users, residents, and visitors during all site activities.

The UXOSO maintains a line of communication with the PM, SUXOS, and UXOQCS for project-specific direction and will report directly within the TLI Solutions, (TLI) program safety chain for administrative and technical direction on health and safety matters.

The UXOSO will implement the approved project/site-specific plans and the safety program in compliance with DoD, Federal, state, and local statutes and codes; analyze UXO and explosives operational risks, hazards, and safety requirements; establish and ensure compliance with site-specific safety requirements for UXO and explosives operations; enforce personnel limits and safety exclusion zones (EZs) for UXO and explosives operations and UXO and explosives transportation, storage, and destruction; and conduct safety inspections to ensure compliance with UXO and explosives safety codes. The UXOSO has authority to temporarily stop work to correct an unsafe condition or procedure.

The UXOSO is to be physically on-site whenever project-related fieldwork is in progress.

UXOQCS

The UXOQCS will be the single POC for on-site quality issues. The UXOQCS will be responsible for monitoring site activities for compliance with plans, procedures, and regulations relative to quality in meeting the project statement of objectives. The UXOQCS is additionally responsible for:

- Monitoring activities affecting quality during the intrusive investigation operations.
- Ensuring that procedures are being carried out in accordance with established requirements and protocols.
- Performing QC activities per the approved project/site-specific plan, specifically

the QAPP.
- Preparing the Daily Quality Control Report (DQCR).

The UXOQCS position may be combined with UXOSO when there are 15 or fewer people on-site. The UXOSO or UXOQCS/SO will not be involved in any MEC removal or investigation tasks.

The UXOQCS maintains a line of communication with the PM, SUXOS, and UXOSO for project-specific direction and will report directly within the TLI program quality management chain for administrative and technical direction on quality management matters.

UXO Technician III (UXO T-III)

The UXO T-III supervises a UXO team performing intrusive investigation operations. The UXO T-III may also serve in the capacity of Demolition Supervisor during demolition and explosives demilitarization operations (MEC SOP 18-04-XX). The UXO T-III is responsible for:

- Supervising the team to which he/she is assigned.
- Providing MEC subject matter expertise to ensure the team’s safety and the project’s quality.
- Ensuring the team’s action is accomplished safely and efficiently.
- Maintaining administrative records related to the team’s operations.
- Implementing the project/site-specific work, safety, and quality plans.
- Being familiar with the duties of all assigned personnel and being able to perform all of the functions enumerated for UXO Technicians I and II (UXO T-I and T-II).

UXO Technician II (UXO T-II)

The UXO T-II is the primary MEC worker on the site and performs as part of the team to locate, visually identify, remove, and dispose of MEC, munitions debris (MD), MPPEH, and non-munitions related debris (NMRD). The UXO technicians assist in documenting information related to the team’s activities. The UXO T-II will report directly to the UXO T-III and will have the experience/qualifications and be able to perform the functions required in DDESB TP 18 (DDESB, 2020).

UXO Technician I (UXO T-I)

The UXO T-I is the secondary MEC worker on the site and supports the team to locate, remove, and dispose of MEC, MD, MPPEH, and NMRD. The UXO T-I will report directly to the UXO T-III and will have the experience/qualifications and be able to perform the functions required in DDESB TP 18 (DDESB, 2020).

EZs and Authorized Personnel

EZ

An EZ is a safety zone established around an MEC-related operation work area. Only essential project personnel and authorized, escorted visitors are allowed within the EZ.

The size of the EZs applicable to the planned work will be identified in the project/site-specific ESP/ESS and will be based on the greater of either the Munitions with the Greatest Fragmentation Distance (MGFD) or munitions with the greatest overpressure distance.

If MEC with a greater fragmentation/overpressure distance than the MGFD/munition with greatest overpressure distance is encountered, the EZs will be adjusted in accordance with DDESB TP 16, operations will continue, and an amendment to the ESP/ESS will be submitted for approval (a copy of this document will be available on site). EZs will be adjusted accordingly.

EZs will be established and marked with clearly identifiable markers such as traffic cones or delineators, sandwich boards, etc. Any required signs will be placed at the entrance to the site or other ingress/egress points associated with the site.

Essential Personnel

Personnel authorized to work within the EZ are defined as Essential Personnel. Essential Personnel are USACE project personnel necessary for the safe and efficient completion of field operations conducted in an EZ. This is limited to: TLI work team members including the UXOSO, UXOQCS, SUXOS, and a USACE Ordnance and Explosive Safety Specialist (OESS).

Essential Personnel will maintain the minimum Team Separation Distance (TSD), as identified in the ESP/ESS, from other teams working in the area. This includes the UXO teams.

Visitors

Authorized Visitors are defined as DoD, Army, USACE, or other personnel conducting project-related functions, such as Quality Assurance Representatives (QARs), safety and quality inspectors, and project management. Authorized visitors must be escorted while in the EZ and be approved for entry into the EZ per this SOP and EM 385-1-97. No more than two authorized visitors will be permitted in the EZ at any given time.

Persons requesting access to the EZ must demonstrate a legitimate need for access and obtain authorization from the PM and UXOSO and must submit their access request prior to the site visit.

Prior to entry, visitors must receive a site-specific briefing describing the specific hazards and safety procedures to follow and must acknowledge the receipt of the briefing in writing.

Any authorized visitor who violates established safety procedures will be immediately escorted out of the EZ for the visitor’s own protection and to protect essential personnel in the EZ.

TSDs

TSD is the distance that Essential Personnel must be separated by during the conduct of MEC activities on an MEC site. The TSD between UXO teams for the project will be specified in the approved ESP/ESS. This value will be calculated and reviewed for each area if munitions with greater MGFDs are discovered to ensure proper and safe separation of teams.

Tasks not necessary to the operation will be prohibited within the immediate area of the hazard produced by the operation. Multi-discipline and multiple MEC project teams performing tasks required to execute the munitions response may be in the EZ while MEC procedures are being performed as long as TSDs are maintained. This must be coordinated with the UXOSO and OESS, if applicable.

Equipment QC Checks

Hand-Held Detector

All hand-held geophysical instruments must be inspected and verified to be functional prior to use by site personnel. Detection equipment/instruments that are new, spare, or requiring repair must be inventoried, inspected, and verified to be functional prior to use.

Equipment QC Checks

All hand-held geophysical instruments QC checks, as described below, are to be performed on a daily basis (if the instrument is to be used that day) regardless of what activity the instrument will support (survey, escort, analog geophysics, etc.). All hand-held detector equipment QC checks will be recorded and documented.

Battery Check

When turning on the detector, the operator will perform a battery check per the manufacturer's instructions. It is recommended to frequently replace the batteries.

Personnel Test

The operator will perform personnel tests to determine whether any metal on his or her person (clothing, jewelry, metallic components of boots/shoes, etc.) affects detector response. The operator will swing the detector well away from the body (as when performing production survey), move the swinging motion and detector closer to the body and over the feet, and observe and listen for any change in instrument response. The operator will remove and/or replace personal items interfering with instrument response. The operator will record daily personnel tests as well as instances where tests were failed and corrective actions were taken.

Instrument Verification Strip (IVS) and/or Test Strip

Detection instrument and operator performance at an IVS and/or test strip will be required for intrusive investigation of analog geophysics "mag and dig" and reacquired DGM anomalies. The project/site-specific plans will provide detailed procedures for the siting, construction/installment, and procedures for IVS and/or test strip.

"Mag and Flag"/"Mag and Dig" Sweep Process

This only applies to the "mag & flag" and/or "mag & dig" technique when analog geophysics are used and not for DGM-acquired anomalies. The UXO T-III will assign UXO technicians a work area to investigate. Once establishing their sweep lanes, the UXO technicians will follow techniques and procedures outlined in EM 200-1-15, specifically concerning velocity, coverage, and detection and recovery, which are summarized below:

- UXO technicians will move with slow, deliberate motions, while avoiding abrupt movements.
- Velocity (speed at which technician walks) - Ensure that personnel movement is 98% ≤ 0.45 meter per second (~1 mile per hour); 100% ≤ 0.5. This will be measured using a GPS tracking device per operator.
- Coverage – Verify for each survey unit or verified at least once daily if less than one survey unit is worked in one day. This will be verified through visual inspections such as photographic records, video recording, of survey lanes/line OR using sub-meter accuracy track-plot (filtered) of each operator's progress through assigned survey lanes.
- Detection and Recovery – Verify that QA blind seeding was completed.

Excavation Process

This excavation process is the same for DGM-acquired anomalies as well as anomalies investigated using the "mag and dig" technique. The UXO T-III will assign UXO technicians DGM-targeted anomalies or a work area to investigate. Anomaly excavation will be performed to a depth specified in the project/site-specific plan. If the UXO team has dug to the maximum depth and still not uncovered the anomaly, the UXO T-III will request direction from the UXOQCS. Unless otherwise directed, the UXO team will mark the location and record the fact that no anomaly was detected to the maximum depth.

The specific excavation steps are outlined below:

- Start all excavations from the side of the anomaly. A hand-held metal detector (e.g., Vallon, Whites, Schonstedt, etc.) will be used to locate the boundaries of the anomaly. Carefully dig from the side until identification of the anomaly is made. Until the anomaly is otherwise identified, it will be assumed that the anomaly is MEC. Excavation operations, whether by hand or Earth-Moving Machinery

(EMM), will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over suspected MEC.

- Clear debris/dirt from the subsurface anomaly only enough to permit identification of the anomaly and to apply the necessary MEC procedure.
- Avoid impacting, jarring, or striking UXO.
- Do not subject UXO to shock, rough handling, heat, or any other force.
- Radios shall not be used within the minimum safe distance (MSD) from MEC as specified in Department of Army (DA) Pamphlet (PAM) 385-64, Section 3, paragraph 17-15.g (e.g., the MSD of 5 feet is prescribed for citizens band radios or walkie-talkies). Cell phones shall not be used within the vicinity of suspect ordnance items (EM 385-1-97).
- Once visible, a UXOQP will determine if the item is MEC. If the UXOQP is unable to determine MEC/MPPEH item’s identification, the SUXOS and UXOSO will be notified immediately to make the determination.
- If a MEC/MPPEH item is positively identified by UXOQP, the SUXOS and UXOSO will be notified immediately upon discovery.
- All MD and NMRD will be segregated and managed separately from MEC/MPPEH.
- Once the anomaly is removed, the excavation will be inspected both visually and with the metal detector to ensure that any anomalies present within the maximum dig depth have been removed.
- The UXO T-III/Team Leader (TL) will inform the SUXOS when intrusive investigation activities are completed. At the end of each day, the TL will complete any remaining documentation activities. The completed documentation will be submitted to the SUXOS for review and, if necessary, correction. The documentation will then be placed in the project files (physical and/or electronic) on-site.
- The following guidelines pertain to the discovery of MEC/MPPEH:
  - In the event that MEC is encountered, the item will be guarded until disposal operations can be conducted. The SUXOS and UXOSO will make the determination of whether or not any item of MEC/MPPEH is acceptable to move.

  - MEC/MPPEH that is not safe to move will be left in place and blown-in-place (BIP). The excavation area will be re-checked following the BIP to ensure the objectives of the clearance have been met.
  - MEC/MPPEH that is safe to move will be removed and relocated to a consolidation point on-site for disposal. The consolidation/disposal area will be re-checked following disposal operations to ensure the objectives of the clearance have been met.

MEC/MPPEH, MD, and NMRD removed during intrusive investigation operations will be inspected and disposed of using the procedures outlined in MEC SOP 18-04-XX, *Explosive Demolition for the Disposal of Munitions*; MEC SOP 18-05-XX, *Explosive Management Plan*; and MEC SOP 18-06-XX, *MPPEH and Other Debris Management.*

The UXO T-III/TL will be primarily responsible for documenting intrusive investigation operations for the UXO team per the requirements and methodology detailed in the project/site-specific plan. The TL shall ensure photographic documentation of all MEC items and representative photographs (a minimum of one photo per mag and dig grid, a minimum of one photo per dig team per work day for DGM anomaly removal, or as specified in project/site-specific plans) of MD and other recovered items. An electronic project database will be used to maintain records of the intrusive investigation operations. Databases used to track intrusive investigation results of DGM anomalies will include a description of item(s) removed for each anomaly investigated or as specified in project/site-specific plans. Digital field forms will be loaded onto mobile devices to record daily operations, intrusive operations, quality control, and MEC recovery/disposal. The project/site-specific plan will describe data management for each project.

Environmental protection and restoration measures for access, excavation, and post-excavation activity will be prescribed in the project/site-specific plan or other planning documents.

If, at any time during the excavation, ground water begins pooling in the hole and obscures the bottom of the dig, an attempt to remove the water will be made using available methods (pumping, bailing, etc.). If this effort fails, the excavation will cease for safety reasons and a record made in field documentation.

EMM

EMM may be used to excavate overburden from selected anomalies. EMM will not be used to excavate within 12 inches of an anomaly. Once the EMM is within 12 inches of the anomaly, the excavation will be completed by hand excavation methods. Personnel who are not UXO-qualified may operate EMM only when supervised by a UXO T-III or higher.

If more than one EMM is to be used on-site, the same minimum separation distances required for multiple work teams apply.

EMM operations will be conducted within the guidelines of EM 385-1-1 and 29 CFR 1926, subpart P.

There is no need to harden/shield the EMM to protect its operator when EMM is used to remove the soil overburden to within 12 inches from the anomaly.

Munitions with Unknown Fillers

The external design of some munitions (e.g., 4.2-inch mortar) does not allow for the positive identification of their fillers. If a munition is encountered that is suspected to contain chemical warfare materiel (CWM), or if the identification of the filler cannot be positively identified, the following steps will be taken:

- All work will immediately cease.
- Personnel on the site will withdraw upwind.
- A team consisting of a minimum of two personnel will secure the area to prevent unauthorized access. They will position themselves as far upwind as possible while still maintaining security of the site.
- The SUXOS and/or Site Manager will notify the PM, who will then coordinate with the client team on requesting assistance from the U.S. Army Technical Escort Unit (Tech Escort Unit Operations, Edgewood Arsenal, Aberdeen, Maryland, 410-436-8534 or 410-435-4384). The client team will be responsible for all required notifications and coordination related to the discovery of item(s) suspected to contain CWM.
- The SUXOS will ensure that security on the site is maintained until the arrival of Tech Escort or proper transfer of site security responsibility to the client.
- Only Tech Escort personnel will treat or dispose munitions with unknown fillers.

Communications

Site operations will not be conducted unless on-site communications are available. On-site communications may be accomplished either through the use of field radios and/or cell phone service. If cell phone service is not available, all site personnel must be aware of the location of the closest telephone or have direct radio communications to someone with telephone service available. If used, radios capable of communicating with the project field office or support zone (or site safety representative if field office not established for the project) will be located in each vehicle or taken with teams on foot.

Visual and/or radio communication between personnel in the support zone and personnel in the EZ will be maintained at all times.

The horns of vehicles or air horns, which are provided in each vehicle and EZ, will be used as a backup emergency notification system. The following horn signals will be used to communicate with personnel if the radio is not operable:

- One long blast – “Evacuate the Area”;
- Two short blasts – “All Clear”; and
- Three short blasts – “Emergency Help Required”.

The location of assembly points, emergency evacuation points, emergency routes, and other contents of the APP/SSHP will be discussed as necessary during the tailgate safety meetings. Copies of the APP/SSHP will be maintained in the field office, if applicable, and site vehicles.

Weather and Environmental Considerations

Prior to commencing operations and at periods throughout the day, the SUXOS will obtain local weather reports from radio, internet, or other services. Intrusive investigation operations will not be conducted if electrical storms are within 10 miles (as detected by a storm and lightning detector) of the clearance/disposal area or during severe weather conditions that would impact safety, such as winds exceeding 45 mph (as detected by a pocket weather meter). Additional weather and environmental considerations will be provided in the approved APP/SSHP.

Health and Safety

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

It is TLI's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress that is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed boots, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan (i.e., APP/SSHP) for detailed health and safety procedures. This plan must be reviewed prior to beginning work.

Potential Hazardous Waste Items

Any suspected hazardous material (not MPPEH-related) located will be assessed on a case-by-case basis by the UXOSO or other site lead in consultation with the client team. Material will be suspected to be hazardous if it emits a chemical odor, has caused soil staining, or is contained in a drum or other container commonly used (or marked) for storage of hazardous materials. If in doubt, materials will be reported for investigation, and instructions for future action will be provided.

QA/QC

QC for intrusive investigation operations will be detailed in the project/site-specific plans, specifically the QAPP. However, the hand-held geophysical survey instruments used shall be operated and maintained per manufacturer's instructions and QC checks performed as discussed above.

Comments/Notes

None at this time.

References

Department of Army, Pamphlet 385-64, *Ammunition and Explosives Safety Standards,* October 2013.

DDESB, TP 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

USACE, EM 200-1-15, Technical Guidance for Military Munitions Response Actions, 30 October 2018.

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TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – INTRUSIVE INVESTIGATION OPERATIONS

SOP Number: 18-03-03
Effective Date: 11/30/2020

RECORD OF CHANGES/REVIEW		
Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
18-03-00	2/12/2018	Entirely rewritten from all prior versions
18-03-01	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents. Throughout document – changed “other debris to non-munitions related debris (NMRD).
18-03-02	10/5/2020	Reviewed for accuracy, minor changes made in SOP Descriptions and References sections – updated references to latest available documents. Changed (DDESB, 2016) to (DDESB, 2020). Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.
18-03-03	11/30/2020	Per USACE reviewer comments, added a new section for “Mag & Dig” Sweep Process and moved line items from Excavation Process section into this new section.

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STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) - EXPLOSIVE DEMOLITION FOR DISPOSAL OF MUNITIONS

Page 1 of 24
SOP Number: 18-04-04
Effective Date: 10/5/2020

Technical Approval: ______________________________ Date: 10/5/2020

QA Management Approval: David E. Dobb ______________________________ Date: 10/5/2020

SOP Description

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum procedures and considerations applicable to the conduct of explosives demolition/disposal operations during munitions response actions at Department of Defense (DoD) Munitions Response Sites (MRSs) where Munitions and Explosives of Concern (MEC) operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Plan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)].

This SOP is not intended to contain all project/site-specific requirements but must be used in conjunction with the applicable, approved project/site-specific plans and Federal, state, and local regulations. Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held geophysical instruments will be used) will be documented in individual project/site-specific plans. These procedures may be refined with the concurrence of the project team to adapt to specific site conditions and circumstances. Any refinements, changes, and/or additions to the procedures of the SOP must be documented and approved according to project-specific requirements.

The approved project/site-specific plans must define the regulatory framework under which the munitions response action is being taken and must specify the applicable regulatory requirements for permits, licenses, transportation and storage of explosives, etc.

Implementation of this SOP also requires potential implementation of MEC SOP 18-05-XX, *Explosives Management* and MEC SOP 18-06-XX, *MPPEH and Other Debris Management.*

This SOP and MEC intrusive investigation activities at are to be implemented consistent with the requirements of:

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 16, Revision 5, Methodologies for Calculating Primary Fragment Characteristics, December 2016.

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities,* June 2020.
- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.
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14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

As required, the following equipment is anticipated for disposal operations:

- Remote firing device
- Circuit continuity tester
- Fire extinguisher(s)
- Hand tools (e.g. Shovels, trowel, rake)
- Air horn(s)
- Hand-held radios
- Sandbags
- Vehicle chocks
- Placards
- Crimpers/Det Cord cutter
- Electrical tape
- Differential Global Positioning System (DGPS)

Roles and Responsibilities

Senior Unexploded Ordnance (UXO) Supervisor (SUXOS)

The SUXOS will be responsible for assuring that disposal operations are carried out in a safe, clean, and efficient manner and in accordance with demolition procedures outlined in this SOP. The SUXOS will report directly to the Project Manager (PM) and will have an open line of communication with the UXO Quality Control Specialist (UXOQCS) and UXO Safety Officer (UXOSO).

Demolition Supervisor

Prior to initiation of operations, the SUXOS will designate an experienced and trained UXO Technician III (UXO T-III) to act as the Demolition Supervisor directly controlling all MEC disposal operations. The Demolition Supervisor will be present during all disposal operations or designate a competent, qualified person to be in charge during any absences. The Demolition Supervisor is responsible for providing a pre-demolition briefing and for ensuring that daily records and explosives inventory records are properly completed and that these inventories and records accurately reflect the demolition events conducted and the demolition materials used during that day's operations.

UXOSO

The UXOSO is responsible for ensuring that all disposal operations are being conducted in a safe and healthful manner. The UXOSO will be present during all disposal operations to ensure the demolition team is following all approved procedures and safety requirements. The UXOSO will maintain a Safety Log and report all safety related events to the SUXOS.

The UXOSO will provide the pre-demolition safety briefing to personnel conducting disposal operations. The briefing will include site controls and exclusion zone (EZ) procedures for the site during disposal operations. The UXOSO is responsible for ensuring all hazardous locations are properly marked and safeguards are in place to prevent accidents/incidents as part of the MEC disposal procedures.

Demolition Team Members

All personnel involved in disposal operations will be familiar with the potential safety and health hazards associated with MEC and donor explosives and with the work practices and control techniques used to reduce or eliminate these hazards. During disposal operations, all demolition team members will follow these safety provisions at all times.

Demolition team members must be alert to conditions that may become hazardous due to changing site conditions and communicate the situation to the Demolition Supervisor. Personnel will comply with the disposal procedures and EZ procedures in effect at the site. All personnel directly or indirectly engaged in disposal operations will be thoroughly trained and capable of recognizing hazardous explosives exposures.

Safety and Operational Requirements

During disposal operations, safety is paramount. The protection of personnel, the public, and the environment from fire, blast, noise, fragmentation, and toxic releases is required; therefore, the following safety and operational requirements shall be followed during disposal operations. Failure to adhere to the requirements and procedures listed in the paragraphs below could result in serious injury or death; therefore, complete compliance with these requirements and procedures will be strictly enforced.

Meteorological Conditions

Prevailing weather condition information will be obtained from the U.S. Weather Service and the data logged in the Demolition Shot Log before each shot or round of shots. In order to mitigate the effects of MEC disposal and to ensure the safety of site personnel, the following meteorological limitations and requirements shall apply:

- Disposal operations will not be conducted during electrical storms or thunderstorms;
- No disposal operations shall be conducted if the surface wind speed is greater than 20 miles per hour;
- Disposal operations will not be conducted during periods of visibility of less than one mile caused by, but not limited to, dense fog, rain, sand, or dust storms;
- Disposal operations shall not be carried out on extremely cloudy days that are defined as overcast (more than 80% cloud cover) with a ceiling of less than 2,000 feet;
- Disposal operations will not be conducted during any atmospheric inversion condition (low or high altitude);
- Disposal operations will not be initiated until 30 minutes after sunrise and will be secured at least 30 minutes prior to sunset.

EZ

An EZ is a safety zone established around a MEC-related operation work area. Only essential project personnel and authorized, escorted visitors are allowed within the EZ.

The size of the EZs applicable to the planned work will be identified in the project/site-specific ESP/ESS and will be based on the greater of either the Munitions with the Greatest Fragmentation Distance (MGFD) or munitions with the greatest overpressure distance.

If MEC with a greater fragmentation/overpressure distance than the MGFD/munition with greatest overpressure distance is encountered, the EZs will be adjusted in accordance with DDESB TP 16, operations will continue, and an amendment to the ESP/ESS submitted for approval (a copy of this document will be available on site). EZs will be adjusted accordingly.

EZs will be established and marked with clearly identifiable markers such as traffic cones or delineators, sandwich boards, etc. Any required signs will be placed at the entrance to the site or other ingress/egress points associated with the site.

Engineering Controls for Intentional Detonations

Only engineering controls and mitigation measures, which are listed in the approved ESP/ESS, are authorized for use. The most common engineering controls used during intentional detonations are either soil cover or sandbags.

- Soil Cover. If soil is proposed to be used over a to-be detonated MEC item, the Demolition Supervisor may use one of several computerized models to determine the required thickness of soil cover necessary for the intentional detonation of MEC. The Buried Explosion Module (BEM) is one such computerized model. The methodology used in the BEM is documented in DDESB TP 16 and an EXCEL spreadsheet is available with DDESB TP 16 on the DDESB Secure Website.

- Sandbags. Sandbags may be used for MEC no larger than 155 millimeters (mm). If sandbags are proposed to be used as an engineering control to mitigate the fragmentation and overpressures generated during an intentional MEC detonation, the Demolition Supervisor should refer to HNC-ED-CS-98-7, *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions*, August 1998, its Amendment 1, February 2011 and its Amendment 2, Nov 2014; CEHNCEMM Memorandum, *Safety Advisory: Use of Jet Perforator During Intentional Detonation While Using Sandbag Mitigation for Engineering Controls*, 7 November 2011; and DDESB-PD memorandum of 22 May 2014, Subject: *Revision of DDESB Approval for Use of Sandbags for Mitigation of Fragmentation and Blast Effects Resulting From Intentional Detonation of Munitions*.
- Water Barriers. In some instances it may be necessary to use water as a mitigating agent for the control of blast effect and fragment containment resulting from the intentional detonation of munitions. HNC-ED-CS-S-00-3 contains the requirements necessary when using water as a mitigating agent. Munition specific requirements are available in the Fragmentation Characteristics Database with DDESB TP 16.

Attachment 1 of this SOP, "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites," will be followed when destroying multiple munitions by detonation. Attachment 2 of this SOP, "Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions," may be used when fragmentation throws and fire is a concern.

Site Control

Physical control of the disposal area must be maintained during disposal operations. All personnel who are not essential to disposal operations must evacuate to a safe area.

Physical barricades will be used to block all access roads leading to the worksite. When required for a planned detonation, the barricades will be manned to ensure no one bypasses the barricade and enters the EZ established for the operation.

Observers will be stationed at locations where there is a good view of the air and surface approaches to the demolition point. It will be the responsibility of the observers to notify the Demolition Supervisor to suspend firing if any aircraft, vehicle, or personnel are sighted approaching the disposal area EZ.

General Safety Procedures

Disposal operations will be conducted as required. All MEC/MPPEH will be guarded until it is disposed of.

Disposal operations will not be conducted near overhead power lines, communication lines, utility services, or other structures that may fall within the designated clear zone. Site-specific requirements (i.e., emergency telephone numbers, evacuation routes, points of contact etc.) are detailed in the APP/SSHP.

Telephone or radio communication will be established using cellular phone or portable radio with facility and local emergency response personnel. No radio transmissions or phone calls will take place within 100 feet of the disposal area during positioning or connecting of electrical initiating devices.

A horn will be used to give positive notice of planned demolition shots. The Demolition Supervisor will assure the area is clear of personnel and equipment prior to permitting attachment of initiation devices to the priming charge.

Disposal Procedures

Conducting a disposal operation requires specific steps or actions to be taken to ensure that a safe and efficient operation is conducted. These procedures are outlined in the following sections.

Notification Procedures

Prior to conducting a disposal by detonation, the SUXOS will ensure that all appropriate notifications are made in accordance with the approved plans. Typical notifications include clinic, safety office, security, and fire department; USACE PM/On-Site Representative; and UXO teams and other site personnel that may be affected or have their operations suspended by disposal operations.

A list of current telephone numbers and contacts will be in the approved project/site-specific APP/SSHP, which will be on-hand at the field office, if applicable, and in the possession of the Demolition Supervisor.

Pre-Demolition/Disposal Procedures

Pre-Demo/Disposal Operational Briefing

The UXOSO and Demolition Supervisor will conduct a safety brief for all personnel involved in range operations in the following areas:

- Type of MEC being destroyed;
- Type, placement, and quantity of demolition material being used;
- Method of initiation (electric, non-electric or Non-El);
- Means of transporting and packaging MEC, if applicable;
- Route to the disposal site;
- Emergency procedures;
- Equipment being used (i.e., galvanometer, blasting machine, firing wire, etc.);
- Misfire procedures;
- Post-shot clean-up of range;
- Care and handling of explosive materials;
- Personal hygiene;
- Two-man rule and approved exceptions;
- Potential trip/fall hazards;
- No horseplay on the range;
- Stay alert for any explosive hazards;
- Location of emergency shelter (if available);
- Vehicle parking (vehicles must be oriented out of the site for immediate departure, with keys in the ignition);
- Location of emergency vehicle (keep engine running);
- Wind direction (to assess potential toxic fumes);
- Location of first aid kit and fire extinguisher;
- Route to nearest hospital or emergency aid station;
- Type of communications in event of an emergency; and
- Storage location of demolition materials and MEC awaiting disposal.

Task Assignments

Individuals with assigned tasks will report the completion of the task to the Demolition Supervisor. The types of tasks that may be required are:

- Contact local police, fire department, and Federal Aviation Administration as required;
- Contact hospital/emergency response personnel if applicable;
- Secure all access roads to the range/shot area;
- Visually check range/shot area for any unauthorized personnel;
- Check firing wire for continuity and shunt;
- Prepare designated pits/shots as required;
- Check continuity of detonators;
- Check time/safety fuse and its burn rate;
- Designate a custodian of the blasting machine, fuse igniters or Non-El initiator;
- Secure detonators in a safe location; and
- Place MEC in pit, if applicable, and place charge in desired location;

Disposal Operations

The following actions are to be accomplished during MEC disposal to assure that a safe and efficient operation is conducted:

- Personnel not involved in the disposal operations will act as perimeter guards as directed by the Demolition Supervisor;
- The K328/fragmentation distance for each shot will not exceed the K328/fragmentation distance specified in the approved ESP/ESS;
- Priming shots will occur only after all non-essential personnel have left the EZ, perimeter guards have been positioned, and the required personnel have been notified;
- Activity not associated with the disposal operations will cease and personnel and equipment will be evacuated from the EZ;
- Detonation will not occur until after it is verified that all personnel are outside of the Minimum Separation Distance (MSD) for the operation;
- The Demolition Supervisor will ensure the appropriate notifications have been completed before commencing the operation;
- No smoking, open flame, or fire of any kind within 50 feet of any area where explosive materials are located;
- A designated vehicle will be positioned near the disposal area, with engine running, and directed toward the emergency escape route;
- A minimum of two qualified personnel, one of which will be the Demolition Supervisor, will conduct disposal operations;

- All demolition shots will be dual primed;
- The maximum quantity of explosives that may be disposed of at one time will include the net explosive weight of the item(s) to be disposed of, plus the weight of the donor charge;
- The Demolition Supervisor will keep accurate, up-to-date records of the items disposed of and demolition materials used in the operation;
- Explosive materials will be removed from containers only as they are needed for immediate use;
- Priming setups will only be assembled as they are needed;
- Preparation of electric blasting caps will be accomplished at least 50 feet from other explosive materials;
- The Demolition Supervisor will direct the placement of the initiating explosives. Charges will be placed in such a manner to take full advantage of the effect of the initiating explosive and contribution from the explosive content of the MEC being detonated; and
- Blasting caps or detonators will be attached to the main charge using detonating cord. Only the Demolition Supervisor and one other fully qualified UXO technician will remain downrange to attach the firing system to the donor charges. All other personnel will move to the safe area.

All operations involving detonation of explosives will use the following safety signals. Employees will be made familiar with the signals and actions to be taken.

- WARNING SIGNAL – a series of long audible signals 5 minutes before blast signal.
- BLAST SIGNAL – A series of short audible signals 1 minute prior to the shot.
- ALL CLEAR SIGNAL – A prolonged audible signal following the inspection of the disposal site.

At the end of each day's operations, surface exposed scrap metal, casings, fragments, and related items shall be recovered from the demolition site and will be 100% inspected for explosive materials by UXO technicians and processed as munitions debris (MD) for disposition in accordance with MEC SOP 18-06-XX, *MPPEH and Other Debris Management.*

Prior to and after each shot, the Demolition Shot Record is to be filled out by the Demolition Supervisor with all applicable information. This record will be kept with the Ordnance Accountability Log and reflect the data for each shot.

Electric Detonator Use

An electrical firing system provides better control of the demolition activities. On-site disposal is limited to electrical firing systems due to specific site situations including the potential for aircraft over flights and public access. The following requirements are necessary when using electric detonators and blasting circuits:

- Electric detonators and electric blasting circuits may be energized to dangerous levels from outside sources such as static electricity, induced electric currents, and radio communication equipment. Safety precautions will be taken to reduce the possibility of a premature detonation of the electric detonator and explosive charges of which they form a part. Radios will not be operated while the shot is primed or during the priming process.
- The shunt shall not be removed from the leg wires of the detonator until the continuity check of the detonator.
- When uncoiling or straightening the detonator leg wires, keep the explosive end of the detonator pointing away from the body and away from other personnel. When straightening the leg wires, do not hold the detonator; rather, hold the detonator leg wires approximately one inch from the detonator body. Straighten the leg wires by hand, do not throw or wave the wires through the air to loosen them.
- Prior to use, the detonators shall be tested for continuity. To conduct the test, place the detonators in a pre-bored hole in the ground or place them in a sand bag and walk facing away from the detonators and stretch the wires to their full length, being sure not to pull the detonators from the hole or sand bag. With the leg wires stretched to their full length, test the continuity of the detonators one at a time by un-shunting the leg wires and attaching them to the galvanometer and checking for continuity. After the test, reshunt the wires by twisting the two ends together. Repeat this process for each detonator until all detonators have been tested. This process shall be accomplished at least 50 feet and downwind from any MEC or demolition materials and out of the demolition site and personnel and vehicle traffic flow pattern. In addition, all personnel on the demolition site shall be alerted prior to the test being conducted.

- **NOTE: When testing the detonator, prior to connecting the detonator to the firing circuit, the leg wires of the detonator must be shunted by twisting the bare ends of the wires together immediately after testing. The wires shall remain short circuited until time to connect them to the firing line.**
- At the power source end of the blasting circuit, the ends of the wires shall be shorted or twisted together (shunted) at all times, except when actually testing the circuit or firing the charge. The connection between the detonator and the circuit firing wires must not be made unless the power end of the firing wires are shorted and grounded or the firing panel is off and locked.
- The firing line will be checked using pre-arranged hand signals. The firing line will be checked for electrical continuity in both the open and closed positions and will be closed/shunted prior to connecting the detonator leg wires.
- MEC to be detonated/vented shall be placed and the demolition material placed/attached in such a manner as to ensure the total detonation/venting of the MEC. Once the MEC and demolition material are in place, the detonators will be connected to the firing line. Prior to handling any detonators that are connected to the firing line, personnel shall ensure that they are grounded. The detonators will then be carried to the detonation point with the end of the detonators pointed away from the individual. The detonators are then connected to the detonating cord, Non-El, etc., ensuring that the detonator is not covered with tamping material to allow for ease of recovery/investigation in the event of a misfire.
- Prior to making connections to the blasting machine, the entire firing circuit shall be tested with a galvanometer for electrical continuity and ohm resistance to ensure the blasting machine has the capacity to initiate the shot.
- The individual assigned to make the connections at the blasting machine or panel will not complete the circuit at the blasting machine or panel and will not give the signal for detonation until satisfied that all personnel in the vicinity have been evacuated to a safe distance. When in use, the blasting machine or its actuating device shall be in the blaster's possession at all times. When using the panel, the switch must be locked in the open position until ready to fire, and the single key must be in the blaster's possession.

Shock Tube

Shock Tube Assembly

Step 1. If you are using a new roll of shock tube cut off the sealed end, initiate the small piece and proceed to the directions listed in Step 3. If you are using a pre-assembled shock tube/detonator assembly proceed to Step 1 in Firing Assembly Setup.

Step 2. If you are using a previously cut piece of shock tube, using a sharp knife or razor blade cut approximately 18 inches from the previously cut end, whether or not it was knotted. Initiate the 18-inch piece of shock tube.

Step 3. Using a sharp knife or razor cut the sealed end off of the detonator assembly and initiate the small piece as above.

Step 4. Loosely tie the two shock tube ends to be spliced together in a square knot, leaving at least a 2-inch free end of each end of the shock tube beyond the knot. Push the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube.

Step 5. Push one of the shock tube ends to be spliced firmly into one of the precut splicing tubes provided by the manufacturer, at least ¼ inches. Push the other shock tube end firmly into the other end of the splicing tube at least ¼ inches.

Step 6. Spool out the desired length of shock tube and cut it off with a sharp knife or razor blade.

Step 7. Immediately seal off the shock tube remaining on the spool by tying a tight overhand knot in the cut off end.

Firing Assembly Setup:

Step 1. Lay out the required length of shock tube from demo area to firing point.

Step 2. If there are multiple items to be destroyed using bunch block(s) supplied by the manufacturer, lay out lead lines at demo site to the shot(s) and secure the bunch block with a sandbag, or some other item which will keep it from moving. Figure 1 illustrates the procedure.

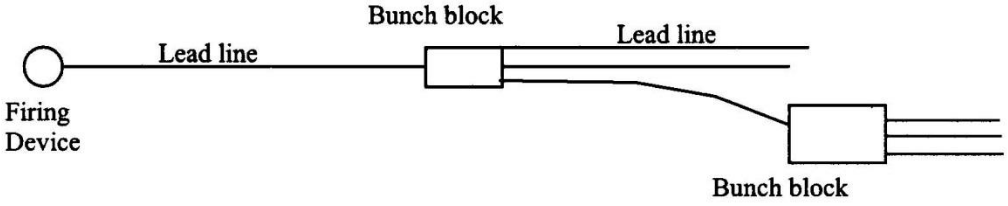

Figure 1

Note: No more than six leads may be used from any one bunch block.

Step 3. If the detonator assembly has not been attached yet, using the splicing tube, splice the detonator assembly to the shock tube lead line as explained in the splicing instructions above.

Step 4. If this is a non-tamped shot, place the detonator assembly into the demolition material. If the shot is to be tamped then prepare the demolition material with a detonating cord lead long enough to stick out of the tamping at least 1 foot.

Step 5. After making a 6-inch loop in the det cord large enough to accommodate the detonator, tape the detonator assembly to the detonating cord lead as shown if Figure 2.

Step 6. Clear the area in accordance with the approved demolition plan, return to the firing position.

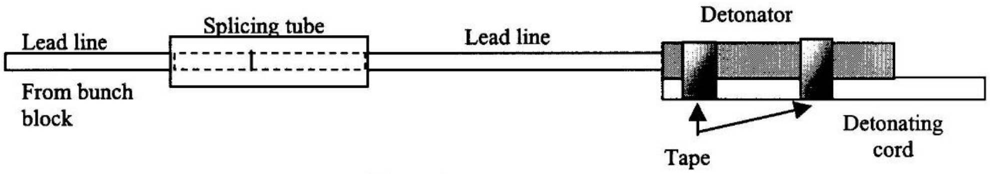

Figure 2

Step 7. Insert a primer into the firing device and connect the shock tube lead line to the firing device ensuring that the shock tube is properly seated in the firing device.

Step 8. Proceed in accordance with the approved demolition procedures.

Shock Tube Splicing – Additional Information

The high reliability of the shock tube initiating system is due to the fact that all of the components are sealed and, unlike standard non-electric priming components, cannot be easily degraded by moisture. Cutting the shock tube makes the open end vulnerable to moisture and foreign contamination; therefore, care must be taken to prevent moisture and foreign matter from getting in the shock tubes exposed ends. Some general rules to follow are listed below.

- After cutting a piece of shock tube, either immediately tie a tight overhand knot in one or both cut ends or splice one exposed end and tie off the other.
- Always use a sharp knife or razor blade to cut shock tube so as to prevent the tube from being pinched or otherwise obstructed.
- Always cut shock tube squarely across and make sure the cut is clean.
- Use only the splicing tubes provided by the manufacturer to make splices
- Every splice in the shock tube reduces the reliability of the priming system; therefore, keep the number of splices to a minimum.

Detonating Cord

The following procedures are required when using detonating cord (det cord):

- Det cord should be cut using approved crimpers and only the amount required should be removed from inventory.
- When cutting det cord, the task should be performed outside the magazine.
- For ease of inventory control, only remove det cord in 1-foot increments.
- Det cord should not be placed in clothing pockets or around the neck, arm, or waist and should be transported to the demolition location in either an approved "day box" or a cloth satchel, depending upon the magazine location and proximity to the demolition area.
- When ready to "tie in" either the det cord to demolition materials or the det cord to detonator, the det cord will be connected to the demolition material and secured to the MEC. The cord is then strung out of the hole/tamping material and secured in place with soil, being sure to leave a 1-foot tail exposed outside the hole/tamping material.

- Once the hole is filled or tamping in place, make a 6-inch loop in the det cord large enough to accommodate the detonator, place the detonator in the loop, and secure it with tape. The detonator's explosive end will face down the det cord toward the demolition material or parallel to the main line.
- In all cases, ensure there is sufficient det cord extending out of the hole/tamping material to allow for ease of detonator attachment and detonator inspection/replacement should a misfire occur.
- If the det cord detonators are electric, they will be checked, tied in to the firing line, and shunted prior to being taped to the loop as described above. If the det cord detonators are Non-El, simply tape the detonators into the loop as described above.

Jet Perforator

The following procedures are required when using perforators:

- Only remove from inventory the number of perforators required to perform the task.
- Transport perforators in an approved “day box,” cloth satchel, or plastic container, depending upon magazine location and proximity to the demolition operations.
- When ready to use, place the det cord through the slot on the perforator and knot the det cord, ensuring the cord fits securely and has good continuity with the perforator. Ensure that the size of the det cord is adequate to initiate the perforator.
- Once the det cord is secure, place the perforator in the desired location and secure it in place.
- Proceed from this point as described in Detonating Cord Use.

Remote Firing Device Preparation

- Perform system pre-operational test and set up using the operator's manual. Remove key from controller unit until ready to fire.
- Place the remote near the detonation site with the antenna in the vertical position. If using electric caps the remote should be within 100 feet of the shot. Using the unit blast shield, sandbags, or natural cover to protect the remote.
- Ensure the remote indicates a READY condition for the selected initiation method.

- If using Nonel, connect the shock tube to the igniter tip. The tube should be wrapped around through holes in the tip's molded casing to keep it from falling out. Prime the shot and return to the safe area.
- If using electric caps, cut off a length of firing wire that will reach between the remote and the charges (100 feet or less).
- Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
- Proceed from this point as described in Electric Detonator Use.

Firing the Remote Firing Device (RFD)

WARNING

The RFD should always be test fired before using live explosives. A RFD which has not been test fired may malfunction, resulting in serious bodily injury or death. Test firing procedures are provided in the RFD Manual.

At the Receiver Unit

- Ensure the power is turned off. Rotate antenna into vertical position.
- Press and hold ON/OFF touch pad until the ON LED illuminates. Wait until the unit completes its self-diagnostics check.
- Prepare the shock tube/Stinger or detonator/cap for attachment. It may be connected to the receiver at this point.
- Press the CHANNEL SELECT button until the channel LED indicates the desired channel.
- Start the receiver arming sequence by pressing and holding the ARM touch pad until the ARM LED begins to flash. Record the start time and start a stopwatch to determine when the five-minute charge time has elapsed. The transmitter will not give any indication of when the charge time is complete.

Upon completing the previous steps, the ARM status LED will begin flashing. The flashing state is an indication that the unit is charging. During this time, commands received over the radio link are ignored. At the completion of the charge time, the ARM status LED stops flashing and remains in a steady on state. Should a validated fire command be received from the transmitter, the unit fires and the ARM status LED flashes approximately ten times per second. All indicators remain in this state until receiver power is cycled (turned off, then back on). At any time before firing, the ARM touch pad may be pressed and held for at least 2 seconds to return the receiver unit to the safe condition. Pressing the ARM touch pad again will restore the unit to the arm condition, which starts a new charge time period.

- The detonators can be connected to the firing train as soon as the arming sequence is started, ensuring that the detonators are not covered with tamping material to allow for ease of recovery/investigation in the event of a misfire. Ensure all personnel are in safe positions before the charge time is completed.

WARNING

Do not touch the RFD receiver after the explosive charge has been attached to the detonator/cap.

CAUTION

The RFD receiver should not be relied on to fire properly if left in an armed state for more than 8 hours. However, low batteries will only cause it to fail to a safe state

At the Transmitter Unit

- Ensure all personnel are at a safe distance from the detonation area.
- Rotate antenna into vertical position. Press and hold the ON/OFF touch pad until the ON LED lights. Wait until the unit completes its self-diagnostic check.
- Press the CHANNEL SELECT touch pad until the LED indicator adjacent to the desired channel is on.
- Insert the safe-arm key card into slot at the base of the transmitter. The FIRE LED will light.

When ready to fire, press and hold the FIRE touch pad on the transmitter until the FIRE LED flashes, indicating the fire command has been transmitted

Misfire Procedures

A thorough check of all equipment, firing wire, and detonators will prevent most misfires. However, if a misfire does occur, the procedures outlined below shall be followed.

Electric Misfires

To prevent electric misfires, one technician will be responsible for all electrical wiring in the circuit. If a misfire does occur, it must be cleared with extreme caution, and the responsible technician will investigate and correct the situation, using the steps outlined below:

- Check firing line and blasting machine connections and make a second initiation attempt.
- If unsuccessful, disconnect and connect to another blasting machine (if available) and attempt to initiate charge.
- If unsuccessful, commence a 30-minute wait period.
- After a 30-minute wait has passed, the demo team leader will proceed down range to inspect the firing system, and a safety observer must watch from a protected area.
- Disconnect and shunt the detonator wires from the leg wires, connect a new detonator to the firing circuit, check the replacement detonator for continuity, and prime the charge without disturbing the original detonator.
- Follow normal procedures for effecting initiation of the charge.

Shock Tube Misfire

The most common cause of misfires is known as “black tube failure.” The shock tube propagates up to the detonator but the detonator fails to function, or there is a crimp in the line causing the shock wave to be interrupted. The following steps will be taken in the event of a misfire:

- If the shock tube fails to propagate and the tube remains clear, remove the shock tube from the firing device, cut off 6 inches of the shock tube, insert a new primer, re-insert the shock tube ensuring that it is properly seated, and re-fire. If you activate the firing device and the shock tube gets blown out of the firing device without activating, cut off 6 inches of the shock tube, replace the primer, and re-insert the shock tube into the firing device.

- If the primer functioned properly and the shock tube was heard or seen to fire, observe the standard 30-minute waiting period prior to going downrange.
- After the 30-minute waiting period has passed, proceed downrange and check the first component in the priming train, i.e. splice, bunch block, or detonator assembly. Repeat this process till you reach the detonator assembly. As you conduct this inspection and discover the problem, replace the firing train, which functioned (tube is no longer clear) with a new one and ensure that all the connections are correct and secure.
- After the system has been checked and repaired/replaced return to the firing point and repeat the firing process.

Detonating Cord Misfire

The det cord may be used to tie in multiple demolition shots and to ensure that electric detonators are not buried. Since det cord initiation will be either electrical or non-electrical, the procedures presented in Electric, Nonelectric, or Non-El Misfires, as appropriate to the type of detonator used, will be used to clear a det cord misfire. In addition, the following will be followed:

- If there is no problem with the initiating system, wait the prescribed amount of time and inspect the initiator to the cord connection to ensure it is properly connected. If it was a bad connection simply attach a new initiator and follow the appropriate procedures in Detonating Cord Use.
- If the initiator detonated and the cord did not, inspect the cord to ensure it is det cord and not time fuze. Also, check to ensure there is pentaerythritol tetranitrate (PETN) in the cord at the connection to the initiator.
- It may be necessary to uncover the det cord and replace it. This must be accomplished carefully to ensure that the demolition charge and the MEC item are not disturbed.

Jet Perforator Misfire

If the perforator is not initiated properly, it could malfunction. Since the perforator is covered with tamping material, the det cord is used as the initiator. Therefore, in the event of a misfire, the procedures presented in Detonating Cord Misfire will be followed, along with the items presented below:

- If everything went but the perforator, one of four things has occurred:
  - Det cord grain size was insufficient to initiate the perforator – check to ensure the grain size of the det cord is sufficient, with 80-grain size or greater being the recommended size.
  - The det cord was dislodged from the perforator when placing tamping materials – if the det cord connection to the perforator was the problem, ensure that the next connection is secured (use duct tape if necessary).
  - The perforator was defective.
  - The perforator was moved during the placement of tamping materials.
- If it is evident that the perforator was moved, ensure it is properly secured for the next shot.
- If cord size and connection are sufficient, replace the perforator, leaving the defective one on the shot.

Remote Firing Device Misfire

- Make three successive attempts to fire.
- On the transmitter, remove the safe-arm key card. The ARM LED will extinguish. Press and hold the transmitter ON/OFF touch pad until the ON LED is extinguished.
- Maintain a safe distance from the receiver for at least 30-minutes after the misfire/no-fire.
- After 30-minutes has elapsed from the time of the misfire/no-fire, approach the detonator/cap. Do not touch the receiver
- Remove any sandbags or soil covering the detonator/cap and carefully detach the detonator/cap from the main explosive charge.
- Disconnect and shunt the electric wires or remove the shock tube from the receiver.
- The receiver may now be safely handled. Note the status of the ARM, ON, and BATTERY LOW LEDs before pressing the ON/OFF touch pad to turn the DFS receiver power off.

- Follow the troubleshooting procedures in Appendix B of the RFD Manual.
- If the cause of the misfire/no-fire can be determined, correct the problem, and perform a test fire following the procedures in Appendix D of the RFD Manual. If the cause of the misfire/no-fire cannot be determined, use a different receiver to perform a test fire, replace the detonator/cap or shock tube, and repeat the firing process.

Post Demolition/Disposal Procedures

Do not approach a smoking hole or allow personnel out of the designated safe area until cleared to do so, and follow the below listed procedures:

- After the Demolition Supervisor gives the “All Clear" signal, the UXOQCS and the Demolition Supervisor will check the pit/shot for low orders or kick-outs.
- Check pit with a magnetometer and remove any large fragmentation.
- Any MEC items failing to be properly disposed of and discovered during the post demolition procedures will be destroyed prior to the end of the day.
- All metal debris larger than failure criteria, as specified in the project/site-specific plan, will be recovered and inspected in accordance with MEC SOP 18-06-XX, *MPPEH and Other Debris Management.*
- Backfill hole as necessary.
- Police up all equipment.
- Notify police, fire, etc. that the operation is complete.
- Obtain accurate Global Positioning System coordinates for each demolition location (whether a centralized demolition location or a blown-in-place location).
- Document whether or not a low order detonation occurred and how it was resolved.

Communications

Site operations will not be conducted unless on-site communications are available. On-site communications may be accomplished either through the use of field radios and/or cell phone service. If cell phone service is not available, all site personnel must be aware of the location of the closest telephone or have direct radio communications to someone with telephone service available. If used, radios capable of communicating with the project field office or support zone (or site safety representative if field office not established for the project) will be located in each vehicle or taken with teams on foot.

Visual and/or radio communication between personnel in the support zone and personnel in the EZ will be maintained at all times.

The horns of vehicles or air horns, which are provided in each vehicle and EZ, will be used as a backup emergency notification system. The following horn signals will be used to communicate with personnel if the radio is not operable:

- One long blast – “Evacuate the Area”;
- Two short blasts – “All Clear”; and
- Three short blasts – “Emergency Help Required”.

The location of assembly points, emergency evacuation points, emergency routes, and other contents of the APP/SSHP will be discussed as necessary during the tailgate safety meetings. Copies of the APP/SSHP will be maintained in the field office, if applicable, and site vehicles.

Health and Safety

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

It is TLI Solutions’ (TLI) policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed boots, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan (i.e., APP/SSHP for detailed health and safety procedures). This plan must be reviewed prior to beginning work.

QA/Quality Control (QC)

QC for demolitions operations will be detailed in the project/site-specific plan, specifically the QAPP.

Comments/Notes

None at this time.

Attachments

The following attachments to this SOP will be reviewed by all UXO-qualified personnel participating in demolition/disposal activities.

- Attachment 1 – Procedures for Demolition of Multiple Rounds Consolidated Shots on Ordnance and Explosives (OE) Sites dated August 1998 (Terminology Update March 2000)
- Attachment 2 – *Use of Sandbags for Mitigation of Fragmentation and Blasts Effects due to Intentional Detonation of Munitions* (HNC-ED-CS-S-98-7 and HNC-ED-CS-S-98-7, Amendment 1, February 2011), August 1998 (includes DDESB Approval dated 23 February 1999 and *Safety Advisory: Use of Jet Perforator During Intentional Detonation While Using Sandbag Mitigation for Engineering Controls* dated November 2011), including 05/2014 revision.

References

Department of Army (DA), Pamphlet (PAM) 385-64, *Ammunition and Explosives Safety Standards*, October 2013.

DDESB, TP 16, Revision 5, *Methodologies for Calculating Primary Fragment Characteristics*, December 2016.

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

USACE, EM 200-1-15, Technical Guidance for Military Munitions Response Actions, October 2015.

USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.

USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

Attachment 1

Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites

**US Army Corps
of Engineers**
Engineering and Support
Center, Huntsville

Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites

AUGUST 1998 (Terminology Update March 2000)

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
2461 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22331-0600

OCT 27 1998

DDESB-KO

MEMORANDUM FOR DIRECTOR US ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY (ATTENTION: SIOAC-ES)

SUBJECT: Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives Sites

References: (a) Memorandum from SIOAC-ESL to Chairman DDESB (ATTN: DDESB-KO), 14 September 1998, SAB

(b) M. Crull and Wayne Shaw, US Army Corps of Engineers, Huntsville, "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites" (August 1998)

The subject procedures forwarded by reference (a) and defined in reference (b) have been reviewed with respect to explosives safety criteria. Based on the information furnished, the procedures proposed in reference (b) for the demolition of consolidated ordnance at OE sites are approved.

Point of contact is Dr. Chester E. Canada, DDESB-KT2 (PH: 703-325-1369, FAX: 703-325-6227, E-MAIL: canadce@hqda.army.mil).

DANIEL T. TOMPKINS
Colonel, USAF
Chairman

Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites

August 1998

Prepared By

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Huntsville Center, Corps of Engineers
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Reviewed by: Wallace C. Watanabe 8/27/98
Chief, Structural Branch Date

Reviewed by: Paul M. [illegible] 8/27/98
Chief, Civil-Structures Division Date

Reviewed by: John C. Potter 8/27/98
Chief, OE Center of Expertise Date

Reviewed by: John D. Mott 8/31/98
Chief, Ordnance & Explosives Team Date

Reviewed by: Wayne Galloway 8/28/98
Chief, OE Safety Date

FOREWORD

The terminology in this report has been updated (March 2000) to reflect terminology used in the field. Specifically the term “personnel separation distance” has been replaced with the term “minimum separation distance for intentional detonations.” This is a change in terminology only, no change in content.

Per discussions with Dr. Chester Canada, Department of Defense Explosives Safety Board (DDESB) and Mr. Cliff Doyle, U.S. Army Technical Center for Explosives Safety (USATCES) this report is not re-submitted to the DDESB for approval.

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LIST OF FIGURES

1.0 Introduction

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) includes the Ordnance and Explosives Center of Expertise (OE-CX). Part of the OE-CX mission is development of procedures for removal and destruction of munitions found on OE sites. Standard procedures are to destroy the munitions by detonation on site. This includes both single round detonation in-place and multiple round detonation (or consolidated shots) at a pre-determined location. The procedures for multiple round detonation are described in this paper.

There are two situations that may describe the consolidated shot process: 1) munitions may be collected from anywhere on site and detonated at a designated, sited disposal area or 2) munitions may be collected within a grid and detonated at a designated spot within the grid. In either situation the same procedures, as described in the following paragraphs, must be followed.

2.0 Placement of Munitions

Munitions shall be placed with their sides touching such that their axis is horizontal as shown in Figure 1. The munitions shall be placed so that the nose of each munition is pointing in the same direction. Munitions shall be oriented so that lugs and/or strong-backs, and nose and/or tail plate sections are facing away from personnel locations.

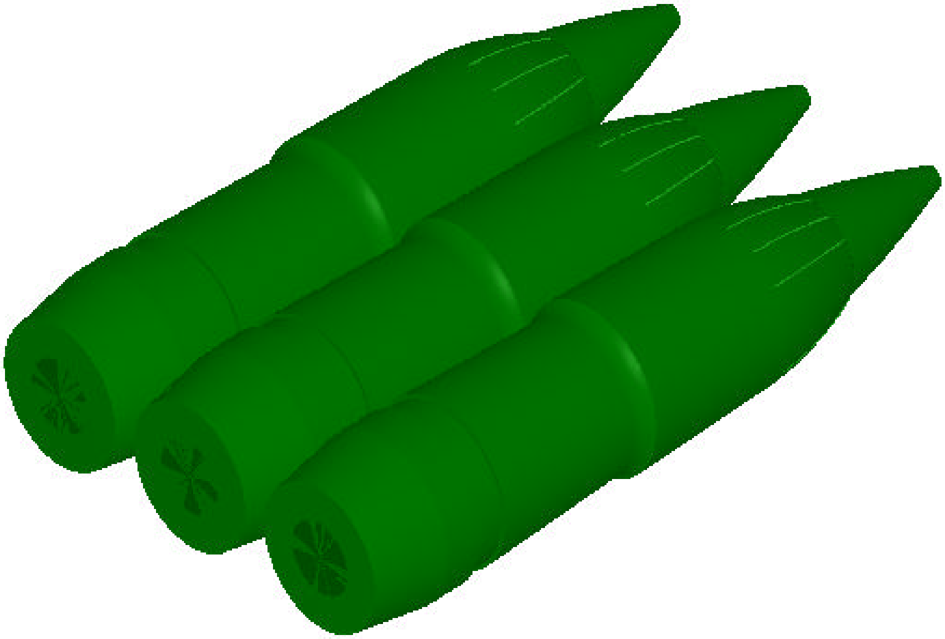

Figure 1 – Placement of Munitions for Consolidated Shots

3.0 Minimum Safe Separation Distance for Intentional Detonations

3.0.1 This document covers procedures for intentional detonations only.

3.0.2 In accordance with DoD 6055.9-STD Chapter 5 paragraph E.4.a(2), the minimum safe separation distance for all personnel will be the greater of the overpressure distance or the appropriate fragment range as determined by the maximum fragment range or the mitigated fragment range.

3.1 Overpressure Distance

In accordance with DoD 6055.9-STD Chapter 5 paragraph E.4.a(2), the allowable overpressure distance will be determined as the scaled distance, K328, based on the total net explosive weight (NEW) of all munitions plus the initiating explosives.

3.2 Fragment Criteria

3.2.1 Maximum Fragment Range

The maximum fragmentation characteristics shall be computed in accordance with HNC-ED-CS-S-98-1. The maximum fragment range shall be computed using these fragmentation characteristics with a trajectory analysis such as the computer software TRAJ. The maximum fragment range shall be the maximum fragmentation distance computed for the most probable munition (MPM) for an OE area at a site, and this shall be the maximum fragment range for a consolidated shot.

3.2.2 Fragment Mitigation

Fragment mitigation may be provided by an appropriate Department of Defense Explosives Safety Board (DDESB) approved engineering control. Typical engineering controls for intentional detonation include tamping and sandbags. The design of such an engineering control shall be based on the maximum fragmentation characteristics of the MPM. The NEW used for the design of the engineering control shall be the total NEW of all munitions plus the initiating explosives. Engineering controls not already approved by DDESB may be submitted (along with appropriate technical data) as part of a site specific explosive safety submission for use at that site. Engineering controls will not be put into use until approved by DDESB and specific applications verified by the appropriate agency; for example, the OE-CX verifies applications for U.S. Army Corps of Engineers.

4.0 Initiation

The consolidated shot shall be initiated in such a manner that detonation of all munitions is simultaneous.

5.0 References

DoD 6055.9-STD, “Department of Defense Ammunition and Explosives Safety Standards”, August 1997.

HNC-ED-CS-S-98-1, Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives, January 1998.

Memorandum, DDESB, DDESB-KO, 27 January 1998, subject: Guidance for Clearance Plans.

Attachment 2

Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions (HNC-ED-CS-S-98-7 and HNC-ED-CS-S-98-7, Amendment 1, February 2011), August 1998 (includes DDESB Approval dated 23 February 1999 and Safety Advisory: Use of Jet Perforator During Intentional Detonation While Using Sandbag Mitigation for Engineering Controls dated & November 2011), including 05/2014 revision

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF:

CEHNC-EMM

7 November 2011

MEMORANDUM FOR RECORD

SUBJECT: Safety Advisory: Use of Jet Perforator During Intentional Detonation While Using Sandbag Mitigation for Engineering Controls

1. References:

a. HNC-ED-CS-S-98-7 and HNC-ED-CS-S-98-7, Amendment 1, February 2011, Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions.

b. Department of Defense Safety Board (DDESB) TP-16, Fragmentation Database.

c. DDESB TP-16, Methodologies for Calculating Primary Fragment Characteristics, Revision 3, 1 April 2009.

2. This safety advisory applies to the U.S. Army Corps of Engineers personnel and its' contractors working on munitions and explosives of concern sites.

3. This advisory is to clarify the proper donor charge to be used during intentional detonation using sandbag mitigation for engineering controls.

4. For munitions listed in the fragmentation database, the sandbag mitigation distance and thickness was calculated using the jet perforator as the initiation charge. The jet perforator is the only approved initiation charge to be used when conducting disposal operations using sandbag mitigation in accordance with reference b.

5. Use of other initiation systems (i.e., boosters) requires the minimum separation distance calculations to be performed by a service recognized, subject matter expert, proficient in the use of reference c in calculating and applying the characteristics of primary fragments.

6. Munitions not specifically listed in the fragmentation database, reference b, must be approved by DDESB or a service recognized, subject matter expert, proficient in the use of reference c in calculating and applying the characteristics of primary fragments.

7. Comments or questions about this safety advisory can be directed to Mr. Walter Zange at 256-895-1586 or Mr. Dave Becker 256-895-1513.

SANDRA M. ZEBROWSKI, P.E.
Director, Environmental and
Munitions Center of Expertise

US Army Corps
of Engineers
Engineering and Support
Center, Huntsville

Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions

HNC-ED-CS-S-98-7 Amendment 2
NOVEMBER 2014

Attachment

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USE OF SANDBAGS FOR MITIGATION OF FRAGMENTATION AND BLAST EFFECTS DUE TO INTENTIONAL DETONATION OF MUNITIONS

Amendment 2

Removing the 200 foot Minimum Separation Distance Requirement

Prepared By
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November 2014

US Army Engineering & Support Center, Huntsville
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PO Box 1600
Huntsville, AL 35807
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Reviewed by: 13 Nov 14
Rick Owens
Chief, Operations Branch
Date

EXECUTIVE SUMMARY

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose *earth* is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, traditionally there has been no method to determine the optimum configuration or the required thickness of such a sandbag enclosure.

The Structural Branch, USAESCH, sponsored a test program in 1997 to evaluate the use of sandbag enclosures for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. Southwest Research Institute (SwRI), under contract to USAESCH, performed a two phase test program of sandbag enclosures. In phase one, the preliminary explosive test phase, four tests on a 155-mm (Comp B filled) projectile were performed to refine and optimize the test procedure. This test procedure was used in phase two, the comprehensive explosive test phase. In phase two, a total of fourteen tests with five different munitions were performed to determine the thickness of sandbags required to capture all primary fragments. Measurements were made of the overpressures at various places, sandbag throw distances, depth of fragment penetration, and noise levels. High-speed film cameras, video recorders and digital cameras were used to visually record the events.

Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Five Tested Munitions

Munition	Charge Weight, Comp B, lb	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	Expected Peak Pressure @ 40 feet, psi	Expected Peak Pressure @ 80 feet, psi	Expected Sound Level @ 100 feet, dB
155-mm M107	15.4	36	220	0.18	0.09	115
4.2-in M329A2	8.17 (TNT)	24	125	0.16	0.06	116
105-mm M1	5.08	24	135	0.18	0.08	120
81-mm M374A2	2.1	20	125	0.14	0.05	119
60-mm M49A3	0.43	12	25	0.08	0.03	118

The results of these tests have been used to develop guidelines for the use of sandbag enclosures. The original document provided guidelines including required sandbag thicknesses, configuration and construction of the sandbag enclosures, and withdrawal distances based on the greater of sandbag throw distances or 200 ft. The original document provides a summary of the test results and these guidelines.

Amendment 1 added Appendix A which summarized tests done using double the original thickness of sandbags and the results of these tests and specified an exclusion zone when using double sandbag mitigation.

This amendment, Amendment 2, removes the 200 ft minimum separation distance and provides separation distances based on the sandbag throw distance with an applied safety factor.

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1.0 INTRODUCTION

All changes to this document as a result of Amendment 2 are shown as "track changes".

The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is currently engaged in projects which require the disposal of uncovered/discarded ordnance and explosives (OE) on public and private lands. The uncovered OE item is often detonated in place if it is too dangerous to move. In some cases, covering and tamping with loose earth is used to contain the blast and fragments. Another method to mitigate the fragmentation and blast effects is to cover the item with sandbags. However, traditionally there has been no method to determine the optimum configuration or the required thickness of such a sandbag enclosure.

The Structural Branch, USAESCH, sponsored a test program in 1997 to evaluate the use of sandbag enclosures for fragment and blast mitigation, for intentional detonations at Ordnance and Explosives (OE) sites. Southwest Research Institute (SwRI), under contract to USAESCH, performed a two phase test program of sandbag enclosures. In phase one, the preliminary explosive test phase, four tests on a 155-mm projectile were performed to refine and optimize the test procedure. This test procedure was used in phase two, the comprehensive explosive test phase. In phase two, a total of fourteen tests with five different munitions were performed to determine the thickness of sandbags required to capture all primary fragments. Measurements were made of the overpressures at various places, sandbag throw distances, depth of fragment penetration, and noise levels. High-speed film cameras, video recorders and digital cameras were used to visually record the events.

The results of these tests have been used to develop guidelines for the use of sandbag enclosures. The guidelines include required sandbag thicknesses, configuration and construction of the sandbag enclosures, and withdrawal distances based on the sandbag throw distances with a safety factor. This document provides a summary of the test results and these guidelines.

2.0 TEST PROGRAM

2.1 Fragmentation Characteristics of Munitions

Prior to beginning this test program the fragmentation characteristics of a variety of munitions frequently encountered during OE site operations were determined. The fragmentation characteristics were calculated in accordance with procedures outlined in DoD Explosives Safety Board (DDESB) Technical Paper 16 (TP 16), "Methodologies for Calculating Primary Fragment Characteristics" [1]. The fragmentation characteristics were used to predict preliminary thicknesses of sand required to prevent perforation for the five munitions tested.

Optimally, the fragments from the munition will strike the sandbags before the blast wave so that the fragments are penetrating undisturbed sand. To ensure that this will occur it is necessary to reduce the coupling between the explosive charge and the surrounding soil. This coupling is dependent on the separation distance between the charge and the soil. Full coupling implies that the maximum amount of energy, or velocity, is transferred from the explosive into the soil immediately adjacent to the charge. If an explosive charge is placed in a cavity, so that an air gap exists between the charge and the walls of the cavity, coupling between the explosive and soil is reduced. Therefore, a standoff of some distance is required to reduce the coupling effect. Calculations to determine the velocity of sand particles from a buried explosion were performed. The velocity of the sand particles was compared to the velocity of the design fragment through sand. These calculations suggest that at a distance between 6 and 12 inches from the explosion, the fragment velocity exceeds the particle velocity. Therefore, the initial standoff distances for the tests were 6 and 12 inches.

2.2 Preliminary Explosive Test Phase

In the preliminary explosive tests, four tests of statically detonated 155-mm M107 (Comp B filled) projectiles were performed. These tests provided the data needed to specify the amount and configuration of sandbags that are required to safely detonate a 155-mm projectile in place, verified that the general test procedure was satisfactory, and defined the instrumentation and data acquisition systems for the subsequent comprehensive explosive tests. Figure 1 shows the site layout for the tests of sandbag enclosures. Although, munitions are rarely oriented vertically for demolition in place, the vertical orientation provided the opportunity to evaluate a greater number of combinations of wall thicknesses and standoff distances. Figures 2 and 3 show the sandbag enclosure configurations for vertical and horizontal weapon tests.

The test matrix for the preliminary explosive tests is shown in Table 1. Two tests were run with the 155-mm in the vertical orientation and two in the horizontal orientation. Each test allowed five standoff distances and five sandbag thicknesses to be evaluated.

The sandbags were made of woven polypropylene, as is commonly used by explosives and ordnance disposal (EOD) personnel, and the volume/weight of the sandbags was either 0.5 ft^3/50 lbs for the large bags or 0.25 ft^3/25 lbs for the small bags. The small bags were used for test two. No additional information was provided by using the small bags so these were not used for any other tests. The bags were filled with a "washed river" sand that was judged to be "typical" by a local soil consultant (Fugro-McClelland Southwest, Inc.).

To determine the sandbag throw distribution some of the sandbags in the first two tests were filled with sand colored with dye. The dye did not improve the quality of the test results. Spray paint was used in the subsequent tests to mark each bag with its original position in the sandbag enclosure. A different color was used to indicate the wall or the roof and numbers were used to indicate the layer in which the sandbag was located.

Detailed descriptions of all tests and results are provided in "Evaluation of Sandbags for Fragment and Blast Mitigation" by Southwest Research Institute [2].

Table 1 – Test Matrix for Preliminary Explosive Tests

Test No.	Orientation	Standoff, in.					Wall Thickness, in. (Bag Size)				Wall Height, in. (Bag Size)	
		S_1	S_2	S_3	S_4	S_R	T_1	T_2	T_3	T_4	H_1	H_2
155-1	Vertical	12	6	6	12	6	32	32.5	45	43	32	20
155-2	Vertical	6	6	6	6	6	18(s)	54	18(s)	53(s)	32	22
155-3	Horizontal	6	6	6	6	6	30	48	24	24	12	30
155-4	Horizontal	6	6	6	6	6	35	36	34	36	12	36

Note: All walls were constructed with large bags, except for those designated with an "s" for small bags.

2.2.1 Preliminary Explosive Test Results

For tests 1 and 2, the 155-mm M107 (Comp B filled) projectile was detonated using a donor charge of 200 g of C-4 placed in the fuze well and initiated with an Exploding Bridge Wire. For tests 3 and 4, the 155-mm M107 projectile was detonated using a well perforator shaped charge. This approach is typically used for on-site detonations. Time of arrival (TOA) pins were used for all tests to determine if a high order detonation was achieved.

All detonations were high order and results were obtained. The make screens and their frames and the assorted witness screens were scattered across the site. Where possible, each screen was identified and photographed and the number of fragment holes or the condition of the screen was recorded. The results of the first three tests suggested that a wall and roof thickness of 36 inches should be sufficient to contain all of the fragments and to reduce the overpressure levels. The dimensions of test 4 confirmed this configuration.

From the limited data collected on standoff distance, it appears that for standoffs of 6 and 12 inches there is no difference in the thickness of sandbags required to stop fragments. Test 2 showed that the size of the sandbag did not affect the fragment penetration. Test 3 showed that the horizontal orientation of the munition did not greatly effect the fragment penetration. Tests 3 and 4 showed that the base plate of the munition broke up and was stopped by 24 inches or less of sandbags.

The data collected showed that approximately 20 inches of sandbags will completely contain the fragments from the 155-mm M107 projectile. The only indications of fragments exiting the sandbag enclosure came from the two identical 18 inch walls of test 2 (external witness screens on sides 1 and 3 both registered fragment impacts). Internal witness screens at depths of 20 inches to 24 inches for all 4 tests did not indicate any fragment impacts. In tests 2 through 4, the roof witness screens also showed no penetrations for 20 to 36 inches of roof depth. The CONWEP software [3] predicts that 24 inches of sand will stop the design fragment from the 155-mm M107 projectile.

Sandbag throw distances were recorded in 10 foot increments from ground zero to the furthest sandbags. The maximum sandbag throw distances were 150 feet, 191 feet, 157 feet, and 150 feet for tests 1 through 4, respectively. All of the furthest thrown sandbags came from the roof. In most cases, the roof sandbags were found relatively intact while the wall sandbags were often disintegrated. The bulk of the sandbags fell within 100 feet with only a few beyond this distance. An examination of the sandbag throw distances shows that the standoff, the size of the bag, and the weapon orientation did not affect the throw distance to any significant degree.

Blast overpressures were recorded for all 4 tests (see Table 2). As shown, the sandbag enclosures greatly reduced the magnitude of the pressure. In test 3, a digital sound meter was placed 100 feet from ground zero and the maximum sound level recorded was 114.7 decibels.

Table 2 – Blast Overpressures from Preliminary Explosive Tests

Test No.	Side 1				Side 4			
	P1 @ 40', psi	P2 @ 40', psi	P3 @ 80', psi	P4 @ 80', psi	P5 @ 40', psi	P6 @ 40', psi	P7 @ 80', psi	P8 @ 80', psi
155-1	0.67	0.71	ND	ND	0.37	0.38	ND	ND
155-2	1.31	1.18	ND	ND	0.74	0.97	ND	ND
155-3	0.16	0.16	0.07	0.06	0.16	0.18	0.09	ND
155-4	0.04	0.04	0.03	0.03	0.07	0.08	ND	0.05

ND = no data

2.3 Comprehensive Explosive Tests

An additional fourteen tests were performed: one more using 155-mm M107 (Comp B filled) projectiles, four using 105-mm M1 projectiles, three using 4.2-in M329A2 projectiles, four using 81-mm M374A2 mortars, and two using 60-mm M49A3 mortars. The test matrix for the comprehensive explosive tests is shown in Table 3. For all tests performed with the munition in the vertical orientation, detonation was achieved using a donor charge of 100 grams (50 grams for test 60-1) of C-4 in the fuze well. For all tests performed with the munition in the horizontal orientation, detonation was achieved using a well perforator. TOA pins were used for all tests to check if a high order detonation was achieved.

For each of the comprehensive explosive tests, woven polypropylene 0.5 ft^3 sandbags were filled with 50 lbs of washed river sand. The sandbags were painted and numbered as described in Section 2.2 to indicate their original position in the sandbag enclosure. Moisture content was not controlled nor monitored during the test program.

Pressure gages, a sound meter, high speed cameras, digital cameras and video cameras were used for data acquisition during each test. Internal and external witness screens were used to determine how deeply the fragments moved into the sandbag mass and whether any fragments exited the sandbag enclosure.

Table 3 – Test Matrix for Comprehensive Explosive Tests

Test No.	Orientation	Standoff, in.					Wall Thickness, in.				Wall Height, in.	
		S_1	S_2	S_3	S_4	S_R	T_1	T_2	T_3	T_4	H_1	H_2
155-5	Horizontal	7	7	5	6	7	36	36	36	36	13	36
4.2-1	Vertical	5.5	5.5	5.5	5.5	6	20	24	31	36	19	24
4.2-2	Horizontal	6.5	6.5	6	6	7	24	25	24	24	11	24
4.2-3	Horizontal	6	5	5	6	7	24	25	25	24	11	24
105-1	Vertical	5.5	5.5	5.5	5.5	6	20	26	31	35	25	24
105-2	Vertical	0	0	4	6	6	29	25	19	25	26	23
105-3	Horizontal	7	5	5	5	9	24	24	24	24	13	24
105-4	Horizontal	6.5	6	5	6	7	25	25	24	24	11	23
81-1	Vertical	5	5	6	6	6	12	19	23	30	15	18
81-2	Horizontal	7	6	5.5	7	6	18	24	18	24	9	18
81-3	Horizontal	7	6	5	6	7	18	19	18	19	10	18
81-4	Horizontal	6	5.5	5.5	5.5	8	19	20	19	20	11	18
60-1	Vertical	6	6	6	6	6	13	19	23	30	11	12
60-2	Horizontal	6.5	3	5.5	3	6	12	12	12	12	8	13

All detonations were high order and results were obtained. The assorted witness screens were scattered across the site. Where possible, each screen was identified and photographed and the number of fragment holes or the condition of the screen was recorded. Sandbag throw distances were recorded in 10 foot increments from ground zero to the furthest sandbags. Blast overpressures were recorded for all tests at 40 feet and 80 feet from ground zero. A digital sound meter was placed 100 feet from ground zero. A summary of the results is shown in Table 4.

The final test for each munition was a confirmation test. These included tests 155-5, 4.2-3, 105-4, 81-3 and 60-2. The purpose of the confirmation tests was to model as closely as possible the actual use of sandbags in field conditions. In each test the internal witness screens were omitted. Sandbags were staggered both horizontally and vertically. External witness screens were placed over the roof and the two sides facing away from the pressure gages. After each test, the external witness screens were recovered and inspected for fragment penetrations. No such penetrations were identified. Therefore, the sandbag thicknesses defined in Table 4 are those used in the confirmation tests. For two munitions, the penetration data from internal witness panels suggests that somewhat smaller sandbag thicknesses may be sufficient to capture all fragments. As stated above for the 155-mm M107, internal witness screens show no fragment penetrations for sandbag thicknesses of about 24 inches or more. For the 4.2-inch M329A2 mortar, the internal witness screens show no fragment penetrations deeper than about 18 inches. However, the thicknesses of 36 inches for the 155-mm M107 and 24 inches for the 4.2-inch M329A2 are retained for use in the field, since sandbag throw distances are based on these thicknesses. While possibly thicker than necessary from capturing fragments, the increased total mass of the sandbags results in reduced sandbag throw distances.

Detailed descriptions of all tests and results are provided in "Evaluation of Sandbags for Fragment and Blast Mitigation" by Southwest Research Institute [2].

3.0 GUIDELINES FOR USE OF SANDBAGS

3.1 Enclosure Geometry

Table 5 summarizes the results of the tests. This table specifies the minimum thickness of sandbag walls and roof that is needed to completely contain the fragments for the five munitions that were tested in this project. It also gives the expected maximum sandbag throw distances, the peak pressures at 40 feet and 80 feet, and the sound level at 100 feet, for the five munitions. For safety and conservatism, the expected sandbag throw distances are approximately 10% larger than the largest distances actually measured in the tests. Thus, the expected sandbag throw distances given in Table 5 are conservative in two ways: first, the largest measured sandbag throw distance from all tests of a particular round is used and second, this value is increased by 10%. Due to the already low values of peak pressures, a similar increase in the expected peak pressures was not deemed necessary or justified.

Table 4 – Summary of Results from Comprehensive Explosive Tests

Munition	Sandbag Thickness (in) to Defeat Fragments	Max. Sandbag Throw Distance (ft)		Max Peak Overpressure (psi) @ 40 ft		Max Peak Overpressure (psi) @ 80 ft		Max Noise Level (dB) at 100 ft
		Side of Round	Nose/Tail of Round	Side of Round	Nose of Round	Side of Round	Nose of Round	
155-mm M107 (Comp B filled)	36	200	130	0.06	0.12	0.04	0.05	114.7
4.2-in M329A2	24	110	70	0.12	0.14	0.04	0.06	115.8
105-mm M1	24	120	50	0.17	0.18	0.07	0.08	119.3
81-mm M374A1	20	110	30	0.14	0.08	0.05	0.03	118.3
60-mm M49A3	12	20	20	0.06	0.08	0.02	0.03	117.3

Obviously, the five munition types do not cover all of the munitions that may be encountered. To determine the minimum wall and roof thickness for a particular shell other than those found in Table 5, the approach is as follows:

(1) Determine the initial fragment velocity (V_F) in ft/s, the maximum fragment weight (W_F) in pounds, and the kinetic energy ($W_F V_F^2/2$) in lb-ft^2/s^2 for the particular munition.

(2) Identify the munition with the next largest kinetic energy, from Table 6.

(3) Use the sandbag wall and roof thickness from Table 5 for the munition with the next largest kinetic energy shown in Table 6.

Table 6 provides the maximum fragment weight, the initial fragment velocity, and the resulting kinetic energy for the 5 munition types. The maximum fragment weight and the initial fragment velocity values were determined with the Mott and Gurney equations, as presented in DoD Explosives Safety Board (DDESB) Technical Paper 16 (TP 16) [1].

Table 5 - Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Five Tested Munitions

Munition	Charge Weight, Comp B, lb	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	Expected Peak Pressure @ 40 feet, psi	Expected Peak Pressure @ 80 feet, psi	Expected Sound Level @ 100 feet, dB
155-mm M107	15.4	36	220	0.18	0.09	115
4.2-in M329A2	8.17 (TNT)	24	125	0.16	0.06	116
105-mm M1	5.08	24	135	0.18	0.08	120
81-mm M374A2	2.1	20	125	0.14	0.05	119
60-mm M49A3	0.43	12	25	0.05	0.03	118

As an example, for a shell such as the 3-in Stokes Mortar Round, the maximum fragment weight and initial fragment velocity are 0.0436 lb and 6189 ft/s, respectively. The resulting kinetic energy is 0.835 x 10^6 lb-ft^2/s^2. The next largest fragment kinetic energy in Table 6 is the 4.2-in M329A2 round. Therefore, a sandbag enclosure with a roof and wall thicknesses of 24 inches should be used to contain the fragments and suppress the blast overpressures. The maximum sandbag throw distance with a safety factor is 125 ft. This is greater than the distance to a sound level of 140 db so the minimum separation distance is 125 ft.

Table 6 - Maximum Fragment Weight, Initial Fragment Velocity and Kinetic Energy for Five Tested Munitions

Munition	W_F, Maximum Fragment Weight, lb	V_F, Initial Fragment Velocity, ft/s	Kinetic Energy, 10^6 lb-ft^2/s^2
155-mm M107	0.467	4667	5.085
4.2-in M329A2	0.079	6391	1.613
105-mm M1	0.155	4870	1.868
81-mm M374A2	0.031	6721	0.700
60-mm M49A3	0.033	3605	0.214

Based on this procedure, a more complete list of typical munitions is given in Table 7. This table includes the required sandbag wall and roof thicknesses and maximum expected sandbag throw distances to be used for each munition. For other munitions not listed in Table 7, the procedure given above can be used. The procedure should not be used to extrapolate sandbag thicknesses or sandbag throw distances for munitions with NEW larger than 15.4 lbs of Comp B or with fragmentation worse than the 155 mm M107 (Comp B filled).

3.2 Enclosure Construction Method

The enclosure construction method follows the procedure that was used to build the test enclosures, with a few modifications. Figure 4 illustrates a typical enclosure. Figure 5 shows a photograph of a sandbag enclosure for an 81 mm mortar.

The sandbag fabric should be woven polypropylene. Each bag should have a nominal volume of 0.5 ft^3 and an approximate weight when full of 50 lb. The bags should be filled with washed sand, either dry or in saturated surface dry (that is, slightly moist) condition. Wet sand should not be used. Prefilled sandbags should be protected from the rain by storage on pallets, off the ground surface, and by covering them with a plastic tarpaulin or similar cover to prevent them from becoming saturated with water. The gradations and physical composition of the sand are not critical but it should be at least typical of local construction practice for sand used in foundations and backfill. Minor inclusions of clay or soils materials can be permitted. However, no rocks or stones should be placed in the sandbags. Typically, the sand used for the tests had a density of about 100 pounds per cubic foot and a moisture content of 6-7%.

Four walls of identical thickness should surround the munition. The minimum wall thickness should be the thickness determined using the procedure in Section 3.1 above. The sandbag walls should be stacked to maintain a clear standoff distance of 6 inches between the shell and the inside face of each wall. The interior face of each wall should be vertical but the exterior face can be built with a 1:6 slope (2" horizontal to 12" vertical). If a sloped outer face is used, the thickness of the wall, at the nominal “top” of the wall, 6 inches above the top of the munition, must be no less than the specified required thickness.

Table 7 - Required Wall and Roof Thicknesses for Sandbag Enclosures, with Expected Sandbag Throw Distances and Pressures, for Tested and Non-Tested Munitions

Munition	Charge Weight (lb)	W_F, Maximum Fragment Weight, lb	V_F, Initial Fragment Velocity, ft/s	Kinetic Energy, 10^6 lb-ft^2/s^2	Required Wall and Roof Sandbag Thickness, in	Expected Maximum Sandbag Throw Distance, ft	Minimum Separation Distance, ft
155mm M107*	15.48	0.467	4667	5.086	36	220	220
4.7-in Mark I	6.07	0.591	3566	3.761	36	220	220
105mm M1*	5.08	0.155	4870	1.840	24	135	135
4.2-in M329A2*	8.165	0.079	6391	1.607	24	125	125
4-in Stokes	7.92	0.078	6336	1.570	24	125	125
75mm M48	1.47	0.153	3471	0.922	24	125	125
3-in Stokes	2.1	0.044	6189	0.835	24	125	125
2.75-in M229 Rocket	4.8	0.050	5569	0.777	24	125	125
81mm M374*	2.1	0.031	6721	0.696	20	125	125
37mm MK II	0.53	0.030	5758	0.490	20	125	125
60mm M49A3*	0.42	0.024	5114	0.310	12	25	25
FMU 54A/B	0.357	0.006	9031	0.263	12	25	25
40mm MK2 Mod 0	0.187	0.033	3605	0.215	12	25	25
MK II Grenade	0.125	0.014	3425	0.083	12	25	25
25mm M792	0.096	0.005	5736	0.081	12	25	25
M67 Grenade	0.40625	0.001	7006	0.029	12	25	25
20mm M56A4	0.0264	0.0000011	4941	0.004	12	25	25

* = tested munitions

The sandbags should be placed tightly against each other. All vertical joints should be staggered, so there is no clear line of sight from the munition to the exterior. As the wall is built, each new layer of sandbags should run in opposite direction to the layer below, so that the layers are interlocked (see Figure 6).

At a minimum, a double layer of sandbags shall be used. For example, when a 12" thickness is required, the sandbags should be oriented so that two sandbags are necessary to achieve this thickness (see Figure 7).

After the walls are constructed to a height of 6" above the upper surface of the munition, the shaped charge or other initiator should be placed on the shell. Ideally, the use of shaped charges, such as oil well perforators, is recommended. These add very little to the total charge weight for each detonation, given the highly directional nature of the effects of the shaped charge. Also, the use of shaped charges for initiation parallels test procedures. The shaped charge should be located either on top of the munition or on its side. If it is located on the side of the round, the charge should be tilted downward sufficiently to ensure that the shaped charge jet penetrates the round and is directed into the ground, rather than into the opposite sandbag wall. Generally, a small mound of sand next to the round can be used to establish this orientation.

A sheet of 3/4-inch thick Douglas Fir (or equivalent) plywood should be cut to the dimensions of the cavity between the walls, plus 12 inches in each direction. The plywood sheet is then centered on the walls so that it bears on 6" of each wall. The additional sandbags that make up the roof of the enclosure are then placed on top. As with the side walls, the roof sandbags should be stacked with staggered horizontal joints and alternating directions in each layer. The exterior sides of the roof may also be vertical or have a 1:6 slope. The thickness of the sandbag roof, above the plywood panel, must be the same as the required wall thickness.

After the sandbag layers of the roof have been placed to the correct height, the enclosure is complete and the munition may be detonated.

3.3 Withdrawal Zone

A withdrawal zone is necessary for any detonation. This withdrawal zone applies to everyone, both public and operational personnel. The withdrawal zone is the maximum of the sandbag throw distance orthe distance to a sound level of 140 db. For all munitions tested, the sound level at 100 ft was substantially less than 140 db. The withdrawal zones are also listed in Table 7.

4.0 SUMMARY AND CONCLUSIONS

A test program has been performed to determine the effects of sandbag enclosures for mitigating fragments and blast effects due to an intentional detonation of a munition. A total of eighteen tests on five different munitions were performed. A summary of the test procedures and results are presented in this document.

The results of these tests have been used to develop guidelines for the use of sandbag enclosures to mitigate the fragments and blast effects due to an intentional detonation of a munition. Methods for determining the required sandbag thickness and the resulting sandbag throw distance are detailed in Section 3.0. Figures 4, 5, 6 and 7 show the resulting sandbag enclosures.

5.0 REFERENCES

1. DoD Explosives Safety Board Technical Paper 16, "Methodologies for Calculating Primary Fragment Characteristics", Revision 4, 17 April 2012.

2. "Evaluation of Sandbags for Fragment and Blast Mitigation", D. Stevens, Southwest Research Institute, San Antonio, TX, January 1998.

3. "User's Guide for Microcomputer Programs CONWEP and FUNPRO Applications of TM 5-855-1. "Fundamentals of Protective Design For Conventional Weapons"", Revision 2, D. Hyde, US Army Corps of Engineers Waterways Experiment Station, February 1989.

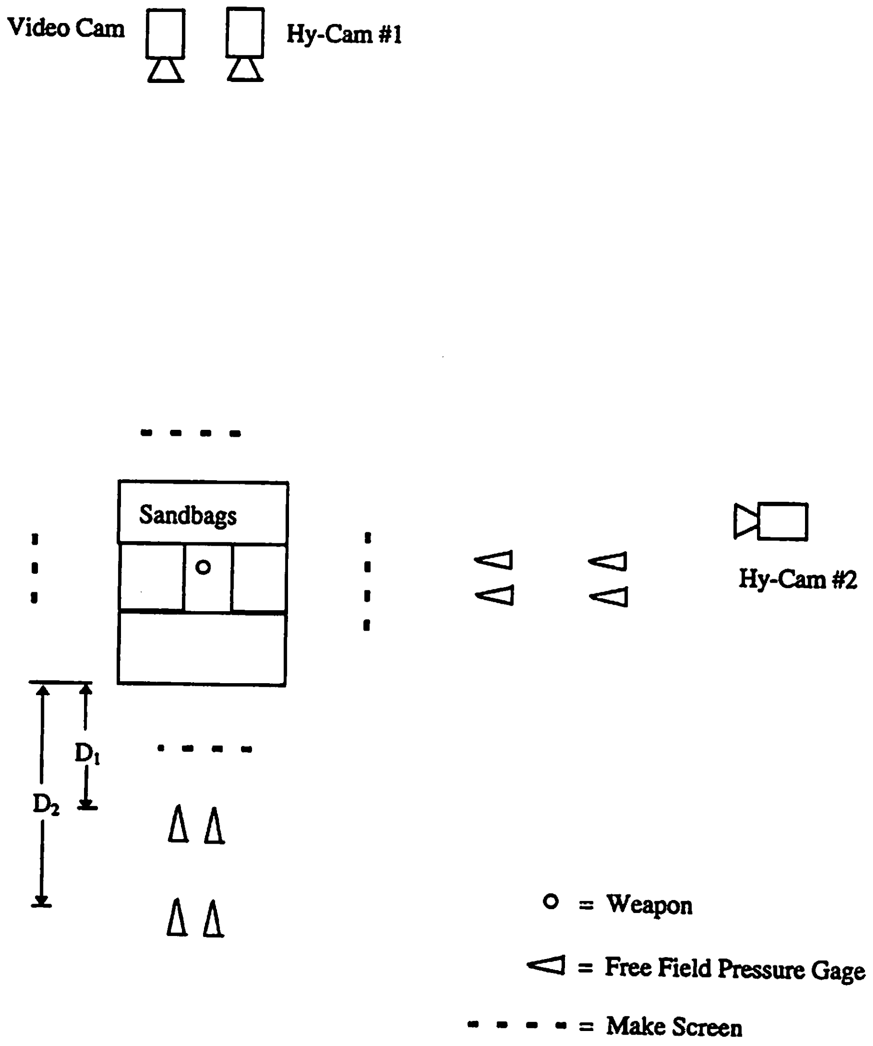
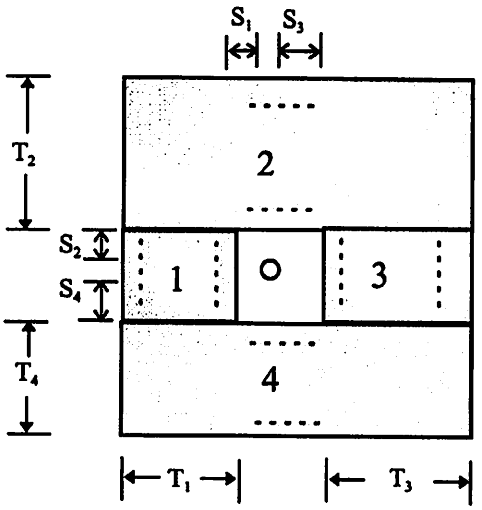
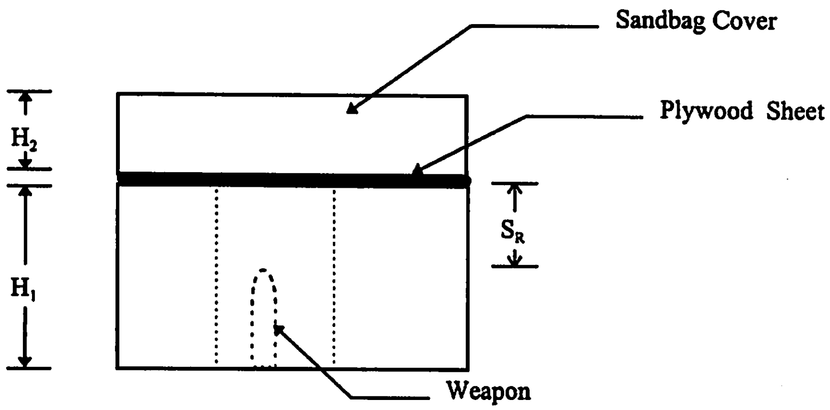


Figure 1 – Site Layout for Tests of Sandbag Enclosures

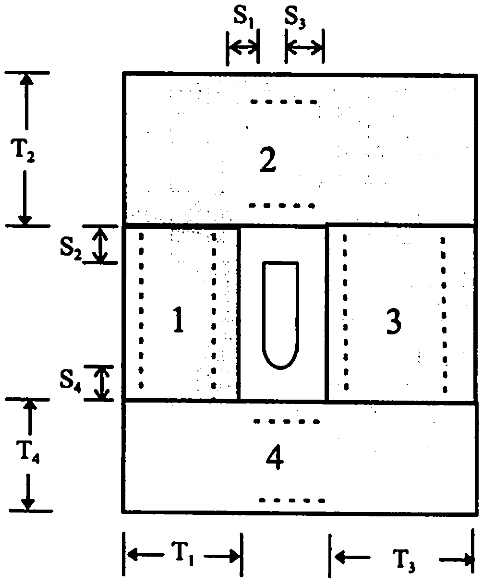


PLAN

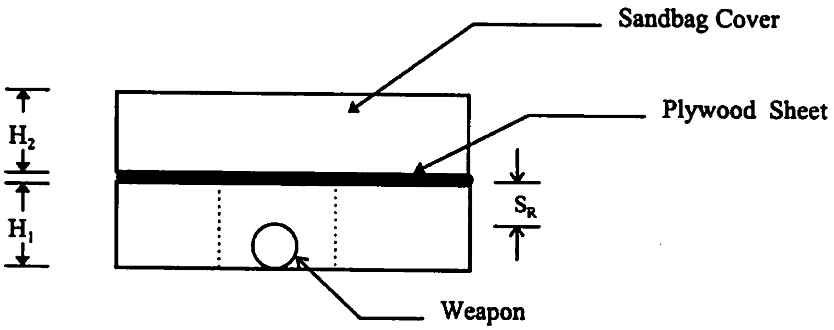


ELEVATION

Figure 2 – Sandbag Enclosure Configuration for Vertical Weapon Tests

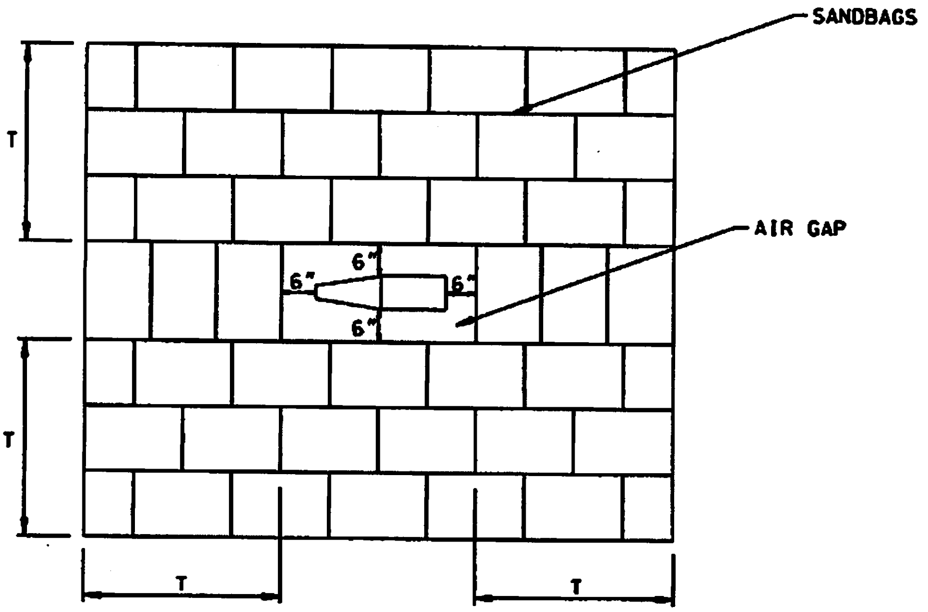


PLAN



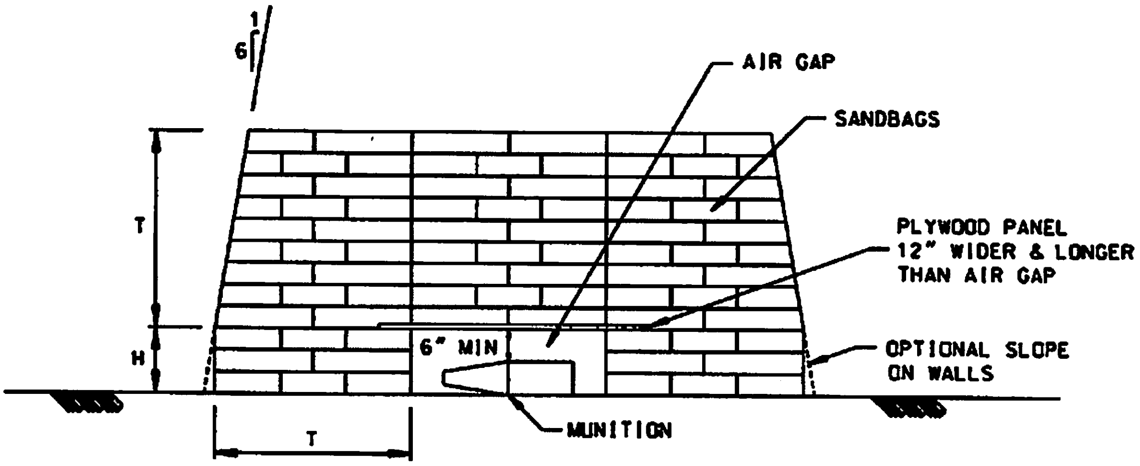
ELEVATION

Figure 3 – Sandbag Enclosure Configuration for Horizontal Weapon Tests



T=THICKNESS OF SANDBAGS REQUIRED FOR SPECIFIC MUNITION

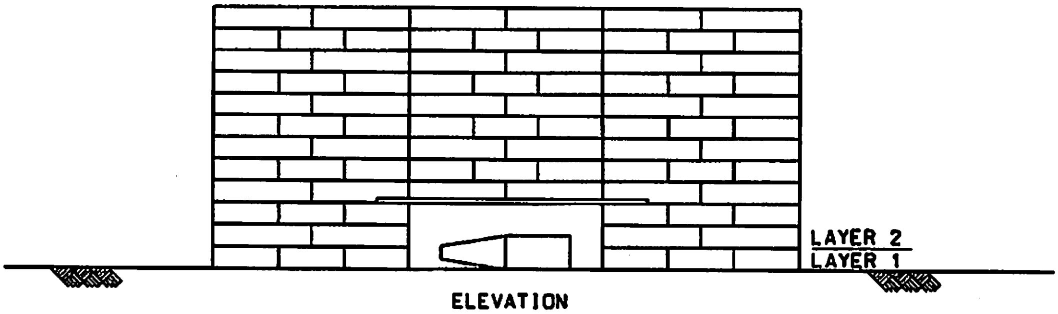
PLAN VIEW AT ELEVATION H
SANDBAG ENCLOSURE



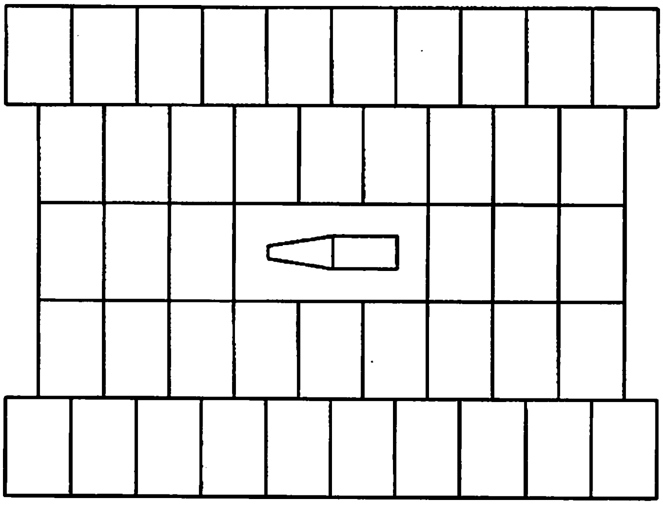
SIDE SECTION VIEW
SANDBAG ENCLOSURE

Figure 4 - Typical Sandbag Enclosure

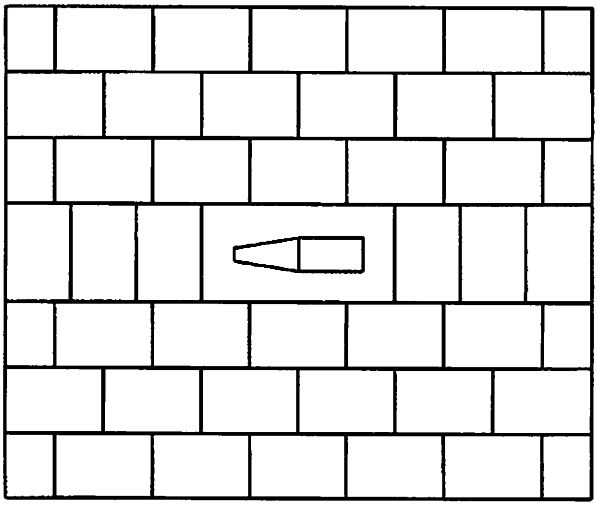
Figure 5 – Sandbag Enclosure for an 81 mm M374A2 mortar



ELEVATION



LAYER 1



LAYER 2

Figure 6 - Interlocking Alternate Layers of Sandbags

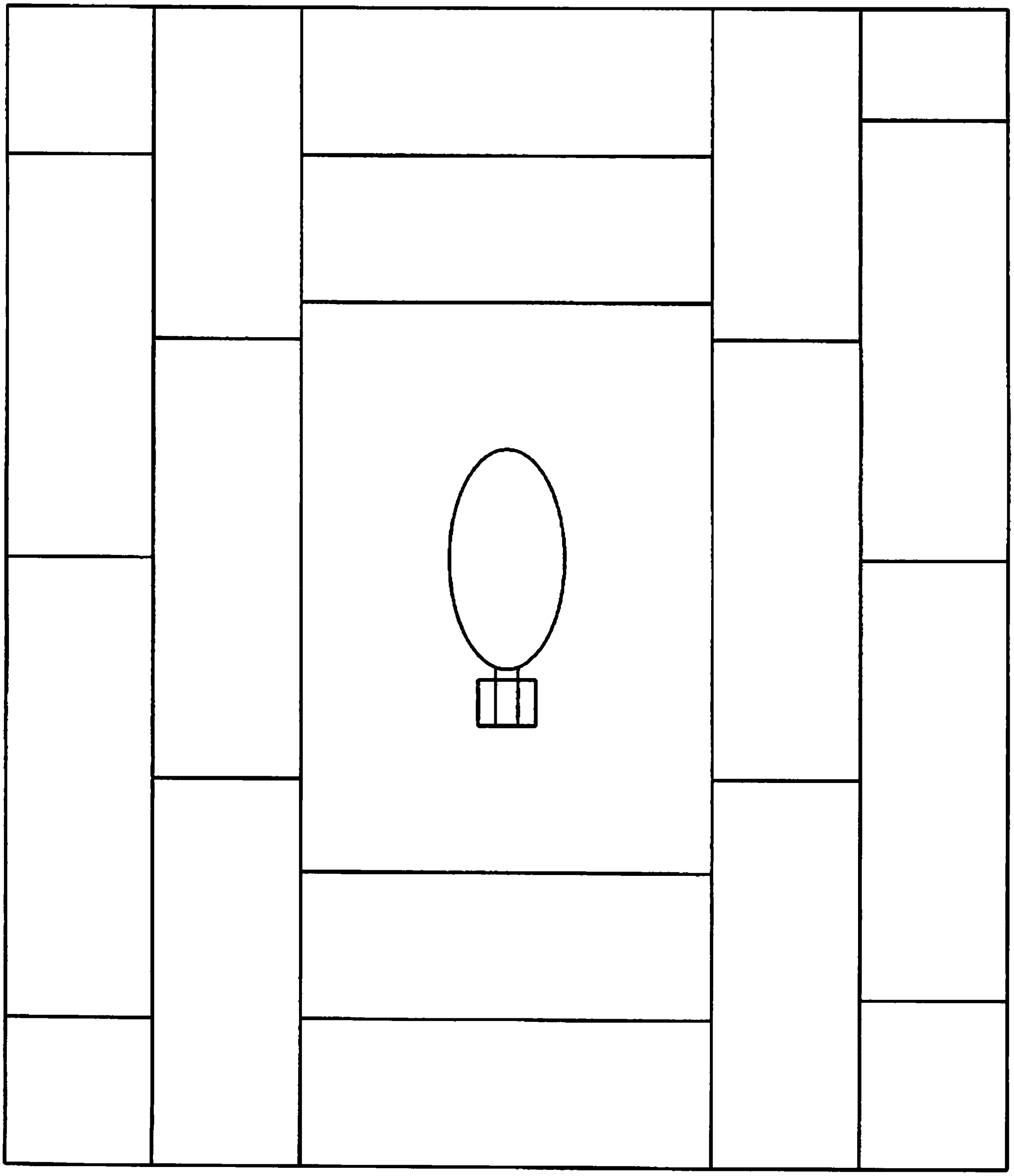


Figure 7 - Configuration for 12-in Wall Enclosures

APPENDIX A

1.0 INTRODUCTION

The use of sandbags for the mitigation of intentional detonations is detailed in HNC-ED-CS-S-98-7 *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to the Intentional Detonation of Munitions* approved in February 1999. This Amendment 1 to HNC-ED-CS-S-98-7 summarizes tests done using double the original thickness of sandbags and the results of these tests and specifies an exclusion zone when using double sandbag mitigation.

1.1 ORIGINAL SANDBAG MITIGATION APPROVAL

The use of sandbags for the mitigation of intentional detonations was originally approved in February 1999. This engineering control is detailed in HNC-ED-CS-S-98-7 *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to the Intentional Detonation of Munitions*. When used in accordance with this report, sandbags reduced the exclusion zone of munitions up to and including 4.2-inches in diameter to 200 ft and of munitions up to and including 155mm in diameter to 220 ft. The required sandbag thicknesses and exclusion zones were based on test data summarized in Table 1-1.

Table 1-1 – Summary of Results from Comprehensive Explosive Tests

Munition	Sandbag Thickness (in) to Defeat Fragments	Max. Sandbag Throw Distance (ft)		Max Peak Overpressure (psi) @ 40 ft		Max Peak Overpressure (psi) @ 80 ft		Max Noise Level (dB) at 100 ft
		Side of Round	Nose/Tail of Round	Side of Round	Nose of Round	Side of Round	Nose of Round	
155-mm M107	36	200	130	0.06	0.12	0.04	0.05	114.7
4.2-in M329A2	24	110	70	0.12	0.14	0.04	0.06	115.8
105-mm M1	24	120	50	0.17	0.18	0.07	0.08	119.3
81-mm M374A1	20	110	30	0.14	0.08	0.05	0.03	118.3
60-mm M49A3	12	20	20	0.06	0.08	0.02	0.03	117.3

With the exception of the 155mm, the basis of the 200 ft exclusion zone was the Corps of Engineers operational policy at the time that no exclusion zone would be less than 200 ft. As shown in Table 1-1, this 200 ft is not necessary from a scientific basis. New minimum separation distances for the original sandbag thicknesses based on the test data are addressed in the main body of this Amendment 2.

2.0 2005 DOUBLE SANDBAG TESTING

Testing was conducted in 2005 to determine if the exclusion zone could be reduced by using double the required thickness of sandbags. This testing was conducted on an operational military munitions response site and munition items recovered on the site were used: Mk II Hand Grenade, 60mm M9A4, 81mm M43, and 75mm M48. Three tests were conducted for each of the Mk II Hand Grenade, 60mm M49A4, and 81mm M43 and two tests were conducted for the 75mm M48. Sound pressures were measured at 12.5 ft, 25 ft and 40 ft from the Mk II Hand Grenade, 60mm M49A4, and 81mm M43 and at 40 ft and 100 ft from the 75mm M48. A common 48" x 48" (single paned, sliding) window was also placed at each of these distances (see Figure 2-1). Results from these tests are shown in Table 2-1.

Figure 2-1 – Typical Test Setup

2.1 Sound Pressure Measurements

The sound pressure measurements were taken using White Seismology, Inc Mini-Seis II-2G Seismographs (see Figure 2-2). The higher pressure readings (~0.29 psi) were at the maximum of the sensor range and, therefore may not be accurate. Additionally, these sensors were most likely measuring ground shock vibrations as well as sound pressures.

Figure 2-2 – Mini-Seis II-2G Seismographs

APPENDIX A

Table 2-1 – Pressure and Sound Measurements for Double Sandbag Mitigation Tests

Munition Tested	Net Explosive Weight (lbs, TNT-Equivalent)	Original Required Sandbag Thickness (in)	Tested Sandbag Thickness (in)	Gage Distance (ft)	Maximum Pressure Reading (psi)	Maximum Sound (db)	Predicted Sound (db)[A]
75mm M48	1.47	24	48	40	0.2784	160	134
				100	0.0998	151	125
81mm M43	1.55	20	48	12.5	0.2877	160	145
				25	0.283	160	139
				40	0.283	160	134
60mm M49A4	0.34	12	24	12.5	0.2854	160	141
				25	0.2459	159	134
				40	0.2227	158	130
Mk II Hand Grenade	0.127	12	24	12.5	0.2854	160	136
				25	0.2459	159	129
				40	0.0232	138	125

[A] Sound was predicted using methods described in USA-CERL Technical Report N-88-07, Richard Raspet and Michael Bobak, *Procedures for Estimating the Flat-Weighted Peak Level Produced by Surface and Buried Charges.* Base values for close-in peak levels were extrapolated from Fig. 1 of this reference.

Peak sound levels were predicted for each of the munitions tested at the same distances at which these levels were measured. The peak sound levels were predicted using the methodologies detailed in USA-CERL Technical Report N-88-07, Richard Raspet and Michael Bobak, *Procedures for Estimating the Flat-Weighted Peak Level Produced by Surface and Buried Charges.* The distances involved in these tests were outside the lower limit of the distances shown for the base condition peak level in this reference. Therefore, these values were extrapolated from Figure 1 of the reference. The peak sound level was then adjusted for the weight and type of explosive and the depth of burial as described in the methodology.

The predicted peak sound levels were much smaller than the measured levels. As seen in Table 2-2, when these are converted to the equivalent pressure the equivalent pressure at all distances is less than 0.065 psi. Therefore, the double sandbags are predicted to provide equivalent K328 overpressure protection at all distances shown in Tables 2-1 and 2-2.

Table 2-2 – Predicted Pressures

Munition Tested	Gage Distance (ft)	Predicted Sound (db)	Predicted Pressures (psi)[A]
75mm M48	40	134	0.0144
	100	125	0.0053
81mm M43	12.5	145	0.0536
	25	139	0.0250
	40	134	0.0149
60mm M49A4	12.5	141	0.0322
	25	134	0.0150
	40	130	0.0090
Mk II Hand Grenade	12.5	136	0.0181
	25	129	0.0084
	40	125	0.0050

[A] Sound/pressure relationship from Cyril Harris and Charles Crede, *Shock and Vibration Handbook, Volume 3*, 1961, Chapter 48.

Standard single paned, sliding 48" x 48" windows were placed at each of the sensor distances (see Figure 2-1). None of these windows broke. The evidence of the windows does not support the high pressures that were measured. The predicted pressures provide much better correlation with the evidence of the intact windows. Additionally, the sandbags were not thrown any measurable distance (in some cases the stack fell over). Again, this evidence does not support the measured pressures.

In hindsight the seismographic equipment used was not the appropriate sensor to measure the overpressures. The pressures recorded greatly exceed those recorded in the first tests which had half of the sandbags to mitigate the pressures, the windows in these tests did not break, and the sandbags in these tests were not thrown distances representative of such high pressures. One possible reason for the high pressure readings may be that the sensors were measuring ground shock which is expected to be high in Hawaii where volcanic rock is very close to the surface. For these reasons, the measured pressures will not be used.

2.2 Sandbag Throw Distances

Double sandbag mitigations produced negligible sandbag throw. Most structures heaved up from the explosion and then collapsed on themselves or fell over. Based on observations and conservative reporting, a maximum value of 10 feet for sandbag throw on ordnance up to a 75mm projectile has been assigned. It is important to note that this value represents only the collapse hazard relative to the height of the structure.

3.0 CONCLUSIONS

Tests showed that when munition items up to and including 81mm in diameter were detonated under twice the thickness of sandbags required by the original approved report, the sandbag throw distance was negligible. The pressure readings from the

2005 tests are suspect and should not be used. Predicted pressures as described 2.1 will be used in determining the exclusion zone.

Therefore, if the thickness of sandbags calculated in accordance with the original report is doubled. The double sandbag mitigation may be used for Non-robust and Robust items up to and including 81mm in diameter which have a net explosive weight not exceeding 1.39 lbs TNT equivalent. For these items using double sandbag mitigation the minimum separation distance is 12.5 ft.

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) - EXPLOSIVE DEMOLITION FOR DISPOSAL OF MUNITIONS

SOP Number: 18-04-04
Effective Date: 10/5/2020

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
18-04-00	2/12/2018	Original
18-04-01	4/27/2018	Fixed time limits in misfire procedures
18-04-02	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents.
18-04-03	3/12/2019	Changed wait time of 60-minutes to 30-minutes for Electric, Shock-Tube, and RFD misfires to match current guidelines.
18-04-04	10/1/2020	Reviewed for accuracy, minor changes made in SOP Descriptions and References sections – updated references to latest available documents. Changed (DDESB, 2016) to (DDESB, 2020). Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – EXPLOSIVES MANAGEMENT

Page 1 of 7
SOP Number: 18-05-04
Effective Date: 6/2/2021

Technical Approval: ______________________________ Date: 6/2/2021

QA Management Approval: ______________________________ Date: 6/2/2021

SOP Description

The purpose of this Standard Operating Procedure (SOP) is to describe the minimum procedures and safety and health requirements applicable in the management, transportation, storage, and accounting of explosives and initiators intended for use during munitions response actions at Department of Defense (DoD) Munitions Response Sites (MRSs) where Munitions and Explosives of Concern (MEC) operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Plan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)].

This SOP is not intended to contain all project/site-specific requirements, but must be used in conjunction with the applicable, approved project/site-specific plans and Federal, state, and local regulations. Consult the documents listed in the reference section of this SOP for additional compliance issues. Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held instrument will be used) will be documented in individual project/site-specific plans. These procedures may be refined with the concurrence of the project team to adapt to specific site conditions and circumstances. Any refinements, changes, and/or additions to the procedures of the SOP must be documented and approved according to project-specific requirements.

The approved project/site-specific plans must define the regulatory framework under which the munitions response action is being taken and must specify the applicable regulatory requirements for permits, licenses, transportation, and storage of explosives, etc.

This SOP addresses typical explosives management required to support munitions response field work that entails delivery of donor explosives by a state licensed vendor for day use. For on-site storage (i.e., in support of long-term field efforts), project/site-specific procedures addressing delivery/acceptance of explosives will be addressed in the "Explosives Management Plan" section of the project/site-specific plans.

This SOP and explosives management activities are to be implemented consistent with the requirements of:

- Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) 5400.7, *Alcohol Tobacco and Firearms Explosives Laws and Regulations*, April 2012.

- DoD 4145.26-M, *Contractor's Safety Manual for Ammunition and Explosives*, August 2018.
- Department of Army, Pamphlet 385-64, *Ammunition and Explosives Safety Standards*, October 2013.
- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.
- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.
- USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.
- USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

- Fire extinguishers
- Explosive placards
- Vehicle wheel chalks
- Tie down straps
- Explosive day box(s)

General

Safety is paramount for explosives operations. The most obvious requirements are to protect personnel, the general public, and the environment from fire, blast, noise, fragmentation, and toxic releases. Proper inspection, handling, packaging, and inventory control are all tasks that must be considered to conduct a safe and efficient operation.

The procedures detailed in this SOP have been developed to ensure safe and efficient MEC and demolition material management is conducted. Absence of a written safety requirement does not indicate that safeguards are not required. Each individual authorized to receive, issue, transport, and use explosives will be identified by name and assume accountability when signing receipt or transfer documents. All transactions relating to explosive material acquisition and expenditures of explosive materials will be maintained for a period of five years. Records will be maintained at the project field office during on-site operations and moved to the TLI Solutions (TLI) corporate office at the conclusion of the field effort.

Coordination

Upon discovery of MEC/material potentially presenting an explosive hazard (MPPEH), including unexploded ordnance (UXO) and discarded military munitions (DMM), and prior to bringing donor explosives on-site and conducting a disposal by detonation, the contractor will complete the necessary coordination and notifications identified in the approved Explosives Management Plan. Vendors delivering donor explosives will use the approved gates and routes identified in project/site-specific plans. Under a "day-use" scenario, no donor explosives will be stored on-site.

Acquisition of Explosives

TLI will use explosives to demilitarize or dispose of MEC encountered during this project. Explosives will be purchased under a Type 33 "User of High Explosives" permit issued by the ATF and state-issued permits. TLI will provide written authorization (example provided in Figure 1) designating the permittees authorized to purchase and receive explosives.

Receipt

In order to ensure that the quantity shipped is the same as the quantity listed on the shipping documents, the authorized receiver and the UXO Quality Control Specialist (UXOQCS), or in his absence the Senior USX Supervisor (SUXOS), will inventory the shipment, comparing the supplier's bill of lading to the freight company's shipping documents, prior to signing for it. A copy of both will be kept with the MEC Accountability Log (example provided in Figure 2).

Storage

Commercial explosives will not be stored on-site. The commercial vendor will deliver the requested amount and type of explosives needed. The delivery will be made the same day of demolition operations.

Transportation

Transportation of explosives will comply with state, local, and Federal regulations.

Certification of Use

The MEC Accountability Log will be completely filled out for every demolition operation by the Demolition Team Leader, who will certify that the explosives were expended as intended in the MEC disposal process or returned to the vendor. The SUXOS will retain the original, as well as copies of the Bill of Lading and shipping documents, in the project files.

Inventory

Commercial explosives and MEC items will not be stored on-site. If it is determined that on-site storage is necessary, a prior-approved project/site-specific plan must address this activity.

Reporting Loss or Theft of Explosive Materials

Discovery of lost or stolen explosive materials will be reported to the TLI SUXOS and Project Manager (PM) immediately. The PM will immediately notify USACE PM by phone and follow-up by written communication within 24 hours. The following information, as a minimum, will be provided:

- Name and job classification of individual making initial report
- Date incident was discovered
- Nomenclature of material involved
- Quantity of material involved
- Date of previous inventory and name of individual(s) conducting the inventory

The ATF will be notified within 24 hours when any theft or loss of explosive material is discovered. The following procedures will be followed by the TLI PM:

- Contact the ATF by phone at (719) 445-5690 between 8:00 AM - 5:00 PM or 1-888-283-2662 after hours and on the weekends to report the loss or theft.
- Contact the local law enforcement office to report the theft or loss and to obtain a police report.
- Complete ATF Form 5400.5 and attach any additional reports, sheets, or invoices necessary to provide the required information and fax or mail the form with the additional material(s) to:

  Bureau of Alcohol, Tobacco and Firearms
  Arson and Explosives National Repository Branch (AENRB)
  P.O. Box # 50980
  Washington DC 20077-8001
  Toll Free Fax: 1-866-927-4570

  Questions regarding the completion of the form should be referred to the AENRB toll free number at: 1-800-461-8841.

Procedures for Return to Storage of Explosives Not Expended

No unexpended explosives will be disposed. All unexpended explosives will be returned to the vendor, who will stand-by on-site, at the completion of the project or at the end of each demolition operation.

Procedures for Disposal of Remaining Explosives

No unexpended explosives will be disposed. All unexpended explosives will be returned to the vendor at the completion of the project or at the completion of the disposal operation.

Health and Safety

The senior UXO-qualified person has final on-site authority on MEC procedures and explosives safety issues.

It is TLI's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress that is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan (i.e., APP/SSHP for detailed health and safety procedures. This plan must be reviewed prior to beginning work.

Fire Protection

Personnel must be alert to fire hazards and ensure good housekeeping practices and fire safety rules prevail throughout explosive operations.

Fire Prevention Requirements

The following guidance is provided to enhance fire prevention within explosives storage/handling and operating locations:

- No smoking, open flame, or fire of any kind within 50 feet of any area where explosive materials are located
- Flammable liquids shall not be used for cleaning in areas where explosive materials are present during operations
- Vehicles will be turned off while loading and unloading explosive materials

Fire Extinguishers

Portable hand-held fire extinguishers within operational areas and on transport vehicles can extinguish fires before major damage is done. The following minimum requirements shall be met:

- Serviceable 20-ABC fire extinguishers shall be maintained in all explosive areas at all times
- The extinguishers shall be mounted for easy unobstructed access
- Two serviceable fire extinguishers shall be present during explosive demolition operations within the demolition operations area (one or more may be located on a vehicle used during the operation)

Communications

Site operations will not be conducted unless on-site communications are available. On-site communications may be accomplished either through the use of field radios and/or cell phone service. If cell phone service is not available, all site personnel must be aware of the location of the closest telephone or have direct radio communications to someone with telephone service available. If used, radios capable of communicating with the project field office or support zone (or site safety representative if field office not established for the project) will be located in each vehicle or taken with teams on foot.

Visual and/or radio communication between personnel in the support zone and personnel in the exclusion zone (EZ) will be maintained at all times.

The horns of vehicles or air horns, which are provided in each vehicle and EZ, will be used as a backup emergency notification system. The following horn signals will be used to communicate with personnel if the radio is not operable:

- One long blast – "Evacuate the Area"
- Two short blasts – "All Clear"
- Three short blasts – "Emergency Help Required"

The location of assembly points, emergency evacuation points, emergency routes, and other contents of the APP/SSHP will be discussed as necessary during the tailgate safety meetings. Copies of the APP/SSHP will be maintained in the field office, if applicable, and site vehicles.

QA/Quality Control (QC)

None at this time.

Comments/Notes

None at this time.

References

ATF 5400.7, *Alcohol Tobacco and Firearms Explosives Laws and Regulations*, April 2012.

Department of Army (DA), Pamphlet (PAM) 385-64, *Ammunition and Explosives Safety Standards*, October 2013.

DoD 4145.26-M, *Contractor's Safety Manual for Ammunition and Explosives*, August 2018.

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

DESR 6055.09, Defense Explosive Safety Regulation Edition 1, January 2019.

USACE, Engineering Manual (EM) 385-1-1, *Safety and Health Requirements Manual*, November 2014.

USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

Authorized Individuals

COMPANY:

FEDERAL ID#:

ATF LICENSE/PERMIT NO:

STATE PERMIT TYPE AND NO:

ADDRESS:

PHONE: **FAX:**

LIST OF INDIVIDUALS AUTHORIZED TO PURCHASE, ACQUIRE, AND ORDER EXPLOSIVES

NAME	POSITION	DATE OF BIRTH	PLACE OF BIRTH	DRIVER'S LICENSE

LIST OF INDIVIDUALS AUTHORIZED TO RECEIVE EXPLOSIVES

NAME	POSITION	DATE OF BIRTH	PLACE OF BIRTH	DRIVER'S LICENSE
STATE PERMIT TYPE AND NO:				
STATE PERMIT TYPE AND NO:				

CERTIFIED STATEMENT OF INTENDED USE OF EXPLOSIVES

The explosives purchased by any of the entities listed above will be used for service work including, but not limited to the demolition and/or venting of munitions and explosives of concern.

"I certify that the information as stated above is true and correct to the best of my ability."

SIGNATURE:

MEC Accountability Log

Team Leader:	**Team:**	**Date:**	
Item Longitude X/Latitude Y (actual)			
Item depth (from center of mass)		Inches	
Item Length		Inches	
Item Diameter/Thickness		Inches	
Item Weight (estimated)		Pounds	
Inclination		0° 45° 90° 135° 180°	
Orientation		N-S NW-SE E-W SW-NE	
Hole Cleared	☐ Visual (48 in.)	☐ Electronic-XLT Serial #	☐ Not Cleared
Item Description/Justification/Comments			
Was photo taken? ☐ Yes ☐ No		File Name:	
Ordnance Positive Identification (If known, record below and record fuze condition and disposition)			
Quantity:	**Ordnance Mark/Mod;**	**Nose Fuze Mark/Mod:**	**Tail Fuze Mark/Mod:**
Ordnance Filler: ☐ Explosive ☐ Propellant ☐ Pyrotechnic ☐ Other			**N.E.W.:**
Ordnance Category:			
☐ Bombs	☐ Clusters/Dispensers	☐ Grenades	☐ Guided Missiles
☐ Land Mines	☐ Misc. Explosive Device	☐ Mortars	☐ Projectiles
☐ Rockets	☐ Pyrotechnics and Flares	☐ Small Arms	☐ Underwater Ordnance
Fuzing Types:			
☐ Piezo-electric	☐ Proximity (VT)	☐ Impact	☐ Base Detonating
☐ All-ways Acting	☐ Electric	☐ Point Detonating (PD)	☐ Influence
☐ Mech long delay	☐ Point-initiating, Base-detonating		☐ Mechanical Time
☐ Pressure	☐ Powder Tran Time Fuze (PTTF)		☐ MT Superquick
Status of Item: ☐ Armed ☐ Unarmed			
Physical Condition of MEC (check all that apply)		☐ Broken open	☐ Soil staining
		☐ Filler visible	☐ Soil sample taken
Final Disposition:			
Destroyed by:	**Signature:**	**Date:**	
Donor explosives used:			
Remarks:			
SUXOS Signature:			

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
18-05-00	2/12/2018	Entirely Rewritten from all prior versions
18-05-01	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents.
18-05-02	3/12/2019	Updated reference dates to latest version.
18-05-03	10/5/2020	Reviewed for accuracy, minor changes made in SOP Descriptions and References sections – updated references to latest available documents. Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.
18-05-04	6/2/2021	Revised the following sections: “Procedures for Return to Storage of Explosives Not Expended” and “Procedures for Disposal of Remaining Explosives.”

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – MATERIAL POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD AND OTHER DEBRIS

Page 1 of 10
SOP Number: 18-06-02
Effective Date: 10/05/2020

Technical Approval: ______________________________ Date: 10/5/2020

QA Management Approval: David E. Dobb Date: 10/5/2020

SOP Description

The purpose of this Standard Operating Procedure (SOP) is to describe the minimum procedures and considerations applicable in the management of material potentially presenting an explosive hazard (MPPEH) and non-munitions related debris (NMRD), to include its inspection, processing, and final disposition during munitions response actions at Department of Defense (DoD) Munitions Response Sites (MRSs) where Munitions and Explosives of Concern (MEC) operations are being conducted in accordance with approved project/site-specific plans [i.e., Uniform Federal Policy-Quality Assurance Project Plan (QAPP), Explosives Site Plan (ESP) or Explosives Safety Submission (ESS), and Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP)].

This SOP is not intended to contain all project/site-specific requirements, but must be used in conjunction with the applicable, approved project/site-specific plans and Federal, state, and local regulations. Any site- and/or project-specific requirements or specifications (e.g., what type of hand-held instrument will be used) will be documented in individual project/site-specific plans. These procedures may be refined with the concurrence of the project team to adapt to specific site conditions and circumstances. Any refinements, changes, and/or additions to the procedures of the SOP must be documented and approved according to project-specific requirements.

An accounting of all recovered munitions-related items and components will be maintained in field logbooks and in an electronic spreadsheet. This accounting will include the official nomenclature, condition, location, and disposition of each item. Inspection, processing, and final disposition of MPPEH and MEC will be performed in accordance with the reference documents listed in the reference section of this SOP.

Implementation of this SOP also requires potential implementation of MEC SOP 18-04-XX, *Explosive Demolition for Disposal of Munitions* and MEC SOP 18-05-XX, *Explosives Management.*

This SOP and MPPEH and NMRD management activities are to be implemented consistent with the requirements of:

- Department of Defense Explosive Safety Board (DDESB), Technical Paper (TP) 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.
- U.S. Army Corps of Engineers (USACE), Engineering Manual (EM) 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.
- USACE, EM 385-1-1, *Safety and Health Requirements*, November 2014.
- USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Materials

- Lockable containers (55-gallon drums, Sea-Land containers, roll-off with lid, etc.)
- Drum/container labels
- Custody seals

Roles and Responsibilities

Unexploded Ordnance (UXO) Qualified Personnel (UXOQP)

These personnel conduct, manage, or oversee MEC-related activities (e.g., reacquire and investigate anomalies, document explosives safety status of materials) required during munitions responses and operational range clearance activities and/or verify the completion of such responses and activities safely and per applicable requirements and approved plans. UXOQP will meet or exceed the requirements for their respective positions as presented in the Department of DDESB-approved “Minimum Qualification Standards” found in TP 18, Revision 1, *Minimum Qualifications for UXO Technicians and Personnel*.

Senior UXO Supervisor (SUXOS)

The SUXOS will be the senior subject-matter expert in the field during the execution of this surface removal. The SUXOS is responsible for:

- Ensuring work and Quality Control (QC) plans specify the procedures and responsibilities for processing MPPEH for final disposition as munitions debris (MD) or NMRD.
- Ensuring a Requisition and Turn-In document, Department of Defense (DD) Form 1348-1A, is completed for all MD and NMRD to be transferred for final disposition.
- Performing random checks to satisfy that the MD and NMRD is free from explosive hazards necessary to complete the Form DD 1348-1A.
- Certifying that all MD and NMRD as free of explosive hazards, engine fluids, illuminating dials, and other visible liquid hazardous, toxic, or radiological waste (HTRW) materials.
- Ensuring that inspected NMRD is secured in a closed, labeled, and sealed container and documented as follows:
  - The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start USACE/Installation Name/Contractor’s Name/0001/Seal’s unique identification and continue sequentially. The SUXOS will report directly to the Project Manager (PM) and will have an

open line of communication with the UXO Quality Control Specialist (UXOQCS) and UXO Safety Officer (UXOSO).

- The container will be closed in such a manner that a seal must be broken in order to open the container. A seal will bear the same unique identification number as the container or the container will be clearly marked with the seal's identification if different from the container.
- A documented description of the container will be provided by the contractor with the following information for each container: contents, weight of container, location where munitions or NMRD was obtained, name of contractor, names of certifying and verifying individuals, unique container identification, and seal identification, if required. The contractor will also provide these documents in a separate section of the final report.

UXOSO

The UXOSO will:

- Ensure the specific procedures and responsibilities for processing MPPEH for certification as MD or NMRD specified in the project/site-specific plans are being followed.
- Ensure that all procedures for processing MPPEH are being performed safely and consistently with applicable regulations.

UXOQCS

UXOQCS will:

- Conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.
- Perform and document random sampling (by pieces, volume, or area) of all MPPEH collected from the various teams to ensure no items with explosive hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials are identified as MD or NMRD as required for completion of the Requisition and Turn-in Document, DD Form 1348-1A.

UXO Technician III (UXO T-III)

UXO T-III will:

- Perform a 100% re-inspection of all recovered items to determine if they are free of explosive hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW materials.
- Supervise detonation of items found to contain explosive hazards or other

dangerous fillers and venting/demilitarization (demil) procedures.

- Supervise the consolidation of MPPEH for containerization and sealing. MD and NMRD will be segregated.
- If material will be consolidated at a location outside the site boundaries, document in their logbook that all material being removed has been inspected and is free of an explosive hazard each day.

UXO Technician II (UXO T-II)

UXO T-II will:

- Perform a 100% inspection of each item as it is recovered and determine the following:
  - Whether the item is a UXO, a discarded military munitions (DMM), MD, or NMRD;
  - Whether the item contains explosive hazards or other dangerous fillers;
  - Whether the item requires detonation;
  - Whether the item requires demil or venting to expose dangerous fillers;
  - Whether the item requires draining of engine fluids, illuminating dials, and other visible liquid HTRW materials.
- Segregate items requiring demil or venting procedures from those items ready for certification.
- Items found to contain explosive hazards or other dangerous fillers will be processed in accordance with applicable procedures.

UXO Technician I (UXO T-I)

UXO T-I can tentatively identify a located item as MPPEH, followed by a required confirmation by a UXO T-II or UXO T-III.

UXO Sweep Personnel

UXO Sweep Personnel will only mark suspected items and will not be allowed to perform any assessment of a suspect item to determine its status.

Inspection and Certification

All removed munitions-related materials and NMRD will be thoroughly inspected in accordance with Department of Defense Instruction (DoDI) Number 4140.62, *Material Potentially Presenting an Explosive Hazard*. The inspection process procedure requires a 100% inspection followed by an independent 100% re-inspection of all MPPEH, both of which will be performed by qualified UXO Technicians (Level II, III, or above). Inspected material will be grouped into one of the following three categories based upon the inspections:

- Material Documented as an Explosive Hazard (MDEH)
- Material Documented as Safe (MDAS)
- NMRD

MPPEH identification procedures and record keeping will be in accordance with USACE EM 200-1-15 and EM 385-1-97, Chapter 1, Section 11. These documents in either hard cover or electronically will be available on-site during intrusive operations.

Marking and Packaging

After munitions-related items have been inspected, processed, and categorized, the MDAS will be consolidated and containerized in sealable and lockable containers (e.g. 55-gallon drums). MD and NMRD will be stored in the same general area and segregated in separate containers. Any item placed in the MD containers will be locked and a chain-of-custody will be maintained until the SUXOS certifies the debris is free of explosive hazards. The USACE Ordnance and Explosives Safety Specialist (OESS), if on-site, or UXOQCS if there is no OESS on-site, verifies that the inspection process has been followed. After inspection, MD and NMRD will be stored in a secured area within the locked containers to prevent materials from being added that may not have been through the inspection process. Upon completion of the certification and verification process, the containers will be locked and or sealed for the final time and a DD Form 1348-1A completed as stipulated in EM 385-1-97, Chapter 1, Section 11 and EM 200-1-15. The disposal contractor will handle transportation and smelting of MD and will provide a certificate of destruction.

The containers will be clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start with "YYY/TLI/0001/Seal's unique identification" and will continue sequentially. An example label would read: YYY/TLI/0001/XXXX (Ys represent the site and Xs represent a seal number).

The container will be closed in such a manner that a seal must be broken in order to open the container. A seal will bear the same unique identification as the container or the container will be clearly marked with the seal's identification if different from the container.

MDAS and NMRD Certification and Verification

The SUXOS and UXOQCS will ensure that the MPPEH and NMRD generated from the munitions response are properly inspected in accordance with the inspection procedures outlined above. Only personnel who are qualified UXO personnel per DDESB TP 18 will perform these inspections. DD Form 1348-1A will be used as documentation. All DD 1348-1A forms must clearly show the typed or printed names, organization, signature, and contractor's home office and field office phone number(s) of the persons certifying and verifying the MPPEH as MDAS. The SUXOS will certify, and the USACE OESS will verify, that the MDAS and NMRD are free of explosive hazards. If there is no USACE OESS on the project, the SUXOS will be the certifier and the UXOQCS will be the verifier.

In addition to the data elements required and any local agreed-to directives, the DD 1348-1A must clearly indicate the following for MDAS and NMRD:

- Type of metal; e.g., steel, aluminum, brass, or mixed
- Estimated weight
- Unique ID number of each container and seal, that is being released
- Location where MDAS and NMRD were recovered
- Seal identification, if different from the unique identification of the sealed container

The following statement will be entered on each DD 1348-1A for turnover of MDAS/NMRD and will be signed by the certifier and the verifier:

> *"This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials."*

Demilitarization

It is anticipated that some of the MDAS recovered could potentially need further demilitarization to render the items unusable and/or unrecognizable as military munitions. MDAS will only be released to a qualified receiver. The following must be accomplished prior to release of the property:

- Ensure that MDAS is only transferred or released to those entities that:
    - Have the licenses and permits required to receive, manage, or process the materials;
    - Are qualified to receive, manage, and process MDAS in accordance with DoD Instruction 4140.62; and
    - Have personnel who are:
        - Experienced in the management and processing of hazardous materials equivalent to the MPPEH.

          Trained and experienced in the identification and safe handling of used and unused military and/or any potential explosive hazards that may be associated with the specific MPPEH.
- The receiver must be advised of all of the potential hazards associated with the MDAS

and agree to receive and process the material in accordance with with DoD Instruction 4140.62.

- All MDAS shipments over public transportation routes must comply with DoD guidance that implements hazardous material transportation regulations.
- Ensure that chain-of-custody and accountability records are maintained through final disposition of MDAS. A legible copy of inspection, re-inspection, and documentation must accompany MPPEH through final disposition and be maintained for a period of 3 years thereafter.

Chain of Custody

The sealed containers and any individual pieces of MDAS too large for a container will be under the control and custody of the UXO Team from the time each container is sealed and labeled until each is turned over to the transporter or recycler for final disposition. The chain of custody identifies the quantity, composition, and the origin, routing, and destination of each container or item during its handling and transportation life cycle and provides evidence that all containers were properly segregated and secured at all times until final disposition. At random times during the scrap process, representative photographs of the containers will be taken to verify that these procedures are being followed.

Final Disposition

MPPEH determined to be MDEH will be properly managed and disposed of in accordance with MEC SOP 18-04-XX, *Explosive Demolition for Disposal of Munitions*.

The certified and verified MDAS will only be released to an organization that will:

- Upon receiving the unopened labeled containers each with its unique identified and unbroken seal ensuring a continued chained of custody, and after reviewing and concurring with all the provided supporting documentation, sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards when received. This will be signed on company letterhead and state that the contents of these sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.
- Send notification and supporting documentation to the project team documenting the contents of the sealed containers have been smelted and are now only identifiable by their basic content.
- This document will be incorporated by the project team into the Final Site-Specific Report as documentation for supporting the final disposition of MDAS.

- If the chain of custody is broken, the affected MPPEH must undergo a second 100% inspection, a second 100% re-inspection, and be documented to verify its explosives safety status.

Material that has been documented as safe is no longer considered MPPEH, but MDAS, as long as the chain of custody remains intact. A legible copy of inspection, re-inspection, and documentation must accompany the material through final disposition and be maintained for a period of 3 years thereafter.

NMRD will primarily consist of recyclable scrap metal. NMRD scrap metal will be segregated from MDAS and containerized in lockable containers until custody is transferred to a local scrap metal recycler. The type of metal and estimated weight will be recorded for each container.

Other debris consisting of non-recyclable solid waste will be segregated from MDAS and consolidated in solid waste receptacles provided on-site for ultimate disposal in the local landfill. Other debris may also consist of potential hazardous waste items. In the event that a potential hazardous waste item is encountered, the SUXOS will notify the PM immediately. The PM will notify the client team and coordinate proper storage, characterization, management, and disposal of the item(s) following the procedures outlined in the project/site-specific plans.

Health and Safety

The senior UXO-qualified person has final on site authority on MEC procedures and explosive safety issues.

It is TLI Solutions (TLI) policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, hard hat, safety glasses, and chemical-resistant gloves.

Refer to a site-specific health and safety plan (i.e., APP or SSHP) for detailed health and safety procedures. This plan must be reviewed prior to beginning work.

QA/QC

QC for MPPEH and other debris management will be detailed in the project/site-specific plan, specifically the QAPP.

Comments/Notes

None at this time.

References

DDESB, TP 18, Revision 1, *Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities*, June 2020.

DoDI Number 4140.62, *Material Potentially Presenting an Explosive Hazard*, August 2018.

USACE EM 200-1-15, *Technical Guidance for Military Munitions Response Actions*, October 2018.

USACE, EM 385-1-97, *Explosives Safety and Health Requirements Manual*, September 2008, with latest applicable errata sheets and Change 1 dated 12 April 2013.

MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) – MATERIAL POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD AND OTHER DEBRIS

SOP Number: 18-06-02
Effective Date: 10/5/2020

RECORD OF CHANGES/REVIEW		
Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
18-06-00	2/12/2018	Entirely rewritten from all prior versions
18-06-01	1/7/2019	SOP Descriptions and References sections – updated references to latest available documents. Throughout document – changed “other debris to non-munitions related debris (NMRD).
18-06-02	10/5/2020	Reviewed for accuracy, minor changes made in SOP Descriptions, Roles and Responsibilities and References sections – updated references to latest available documents. Changed Company name to TechLaw Consultants, Inc. and TLI Solutions.

APPENDIX F.2

DGM – STANDARD OPERATING PROCEDURES

SOP GEO-1a: Global Positioning System

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to present the method for correctly setting up the global positioning system (GPS) at the project site.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP. Any instructions and manuals provided by the manufacturer for equipment referenced below shall be available to site personnel. It is the responsibility of the Site Geophysicist or Field Team Leader to acquire the necessary equipment manuals.

2.1 Personnel

At least two of the following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist
- Quality Control (QC) Geophysicist
- Site Geophysicist
- Field Team Leader or member
- Data Processor

2.2 Equipment and Materials

The following is a list of required equipment:

- Trimble R8, R10, Leica GS18 or similar RTK GPS
- Measuring tape or collapsible measuring pole

The following is a list of materials that may be needed:

- Sandbags or large rocks to secure tripod legs (if necessary)
- 12 volt battery and charger
- Thumb drive, flash drive, or cables to transfer data from survey controller
- Field notebook and pen
- Non-metallic, PVC pin flags
- Surveyor flagging tape
- Wooden stakes
- Permanent marker

3. Procedures and Guidelines

Real time kinematic (RTK) systems operate with base station and rover units. To overcome atmospheric timing delays of satellite signals the systems utilize a base station GPS receiver positioned at a known control point or monument. The GPS base receiver provides real time corrections to the rover receiver via ultra-high frequency (UHF) radio. The GPS base station software corrects for atmospheric timing delays and transmits (via UHF) corrections to the rover unit(s), which combined with the rover's internal receiver produces accuracy that meets or exceeds the requirements for digital geophysical mapping or other location measurement capabilities.

In lieu of a local GPS base station, a Virtual Reference Station (VRS) or satellite-based L-band correction systems may also be used. These systems will meet or exceed the accuracy requirements for digital geophysical mapping or other location measurement capabilities specified in the QAPP.

3.1 Establish a Base Station Location (if necessary)

Position the GPS base station at/above an existing control point or monument. If an adequate control point is not present at the project site, refer to the QAPP for project requirements (e.g., licensed surveyor).

3.2 Set up the Base Station (if necessary)

When using a base station, the following guidelines should be considered upon initial setup of GPS equipment and when establishing control points:

- Securely anchor the base receiver on a tripod, leveled via bubble sight, and accurately position over the known base ground mark with the center leg, plum bob, or borehole sight.
- Calculate the base height based on the fixed tripod's known measurements or manually measure from the control point to the antenna.
- Choose the base station UHF radio transmit power (i.e., watts) based on site conditions. Select the lowest transmit power setting capable of consistently reaching the work site to maximize radio battery life.
- Place the GPS base station radio antenna as high as practical. This enables the radio to broadcast the maximum distance.
- Power up the base receiver and radio. Establish connectivity between the survey controller field computer and the base receiver via Bluetooth or wired connection (if necessary).
- The specific settings will vary slightly from project to project; however, confirm coordinate system, units, receiver height and control point coordinates at this time (if necessary).
- Start base survey (if necessary).

3.3 Set up the Rover

The rover receiver will be utilized in standalone mode to evaluate system functionality, stake out points, and grid corners and other relevant features as necessary as well to record positions of site features pertinent to or affecting geophysical data. When attached to the geophysical instrument, the rover receiver provides data used to position geophysical data.

- Attach the rover(s) receiver to a survey pole.
- Power up the receiver and survey controller field computer.
- Establish communication between the controller and receiver via Bluetooth or wired connection by starting the RTK survey or configuring the system per manufacturer's instructions.

- Open an existing job or create a new job (confirm receiver height).
- Confirm rover-base communication.
- Proceed to the nearest known, good control point or similar quality marker to record a positional QC point. Ensure conformance with specifications in QAPP Worksheet # 22.
- The geophysical sensor's receiver rover must be configured to output National Marine Electronics Association (NMEA) GGA and GSA global positioning system fix data to geophysical acquisition software. NMEA configuration varies by manufacture and model. NMEA output configuration is completed through PC link, smart phone app or field survey controller computer.
- Confirm that the required NMEA sentence is being received at the geophysical equipment acquisition software at the required frequency (e.g., 1 Hz).

3.4 Stake out and Collect GPS Points with Controller

Field personnel may stake out and/or collect GPS points with the controller and range pole.

Mark surveyed points in the field using wooden stakes wrapped in survey/flagging tape or pin flags. Record identifying information directly on the stake or the pin flag using permanent marker.

3.5 Upload Points to the Controller

1. Turn on the controller.
2. Transfer the CSV file to the controller via USB thumb drive, flash card or direct connection to a personal computer (PC) using the import/export functionality associated with the hardware/software version being used. The file shall contain data in the following format with no header: pointID, Easting, Northing, and mV response (optional).
3. Start the survey controller program if it is not already active.
4. Link the CSV file to the survey job being used as necessary.

3.6 Stake out and Measure Points

1. Select a point to stake out (e.g., survey, stakeout, select map or closest).
2. Navigate to the point. Ensure the rover pole is level when refining the location.
3. If measuring points, measure the point while keeping the rover pole level. Ensure the point name is correct. If recording locations during stake out, use the accept or measure function.

3.7 Download Measured Points

1. Connect the controller to a PC or load points onto a portable drive or flash card.
2. Transfer points from the survey controller to the computer or drive (e.g., import/export, fixed format files, select points from list, export CSV file).

4. Data Management

4.1 Establish Grid Corners

- If deviations are necessary, field personnel should record the reason for deviations in a field notebook.

- Field personnel should ensure the actual surveyed coordinates are clearly labeled and transmitted to the Data Processor, Project Geophysicist, and QC Geophysicist upon completion.

4.2 Install IVS

Refer to SOP GEO-3 for IVS installation procedures if IVS installation is required.

Surveyor personnel should ensure the surveyed coordinates are clearly labeled and transmitted to the Data Processor, Project Geophysicist, and QC Geophysicist upon completion.

4.3 Emplace Blind Seed Items

Refer to the Blind Seed Plan if blind seeds are to be emplaced. The Blind Seed Plan discusses these points in further detail:

- Planned and actual coordinates for blind seed items must be firewalled from the Project Geophysicist and data processor, if applicable.
- Planned and actual coordinates for the blind seed items should be deleted from the controller and thumb drive upon completion.
- If deviations are necessary, personnel should record the reason for deviations in a field notebook.

4.4 Flag Anomaly Locations

Refer to SOP GEO-8 for flagging procedures.

- The Project Geophysicist or Data Processor should provide target coordinates to field personnel.
- Field personnel should record the staked out position.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP.	All

SOP GEO-1c: Fiducial Positioning

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to present the method for correctly locating data with fiducials at the project site.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP. Any instructions and manuals provided by the manufacturer for equipment referenced below shall be available to site personnel. It is the responsibility of the Site Geophysicist or Field Team Leader to acquire the necessary equipment manuals.

2.1 Personnel

At least two of the following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist
- Quality Control (QC) Geophysicist
- Site Geophysicist
- Field Team Leader or member
- UXO Technician (optional depending on team composition)

2.2 Equipment and Materials

The following is a list of required equipment:

- Survey tapes (≥200 feet preferable)
- Ropes (at least 100 feet long)

The following is a list of materials that may be needed:

- Inverted marking paint
- Colored tape
- Field notebook and pen
- Non-metallic, PVC pin flags
- Surveyor flagging tape
- Wooden stakes
- Permanent marker

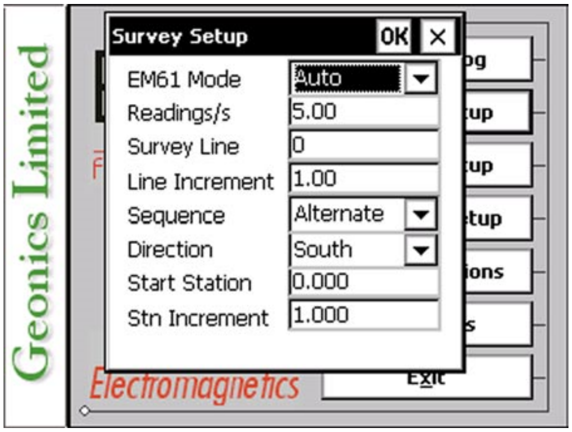
3. Procedures and Guidelines

Where tree canopy and/or terrain inhibits reception of global navigation satellite system (GNSS) signal, it may be necessary to utilize alternative positioning methods such as fiducials. Fiducial positioning measurements are collected in a local coordinate system referenced to surveyed grid corner stakes. Tape measures are pulled between the corner stakes on opposite sides of the survey area. Marked survey ropes are then placed laterally across the survey area at 25-foot intervals; tighter spacing may be required if numerous obstructions are present within the grid. Alternating colored markers on the ropes facilitate straight-line profiling and identify locations for the placement of fiducial marks within the recorded data.

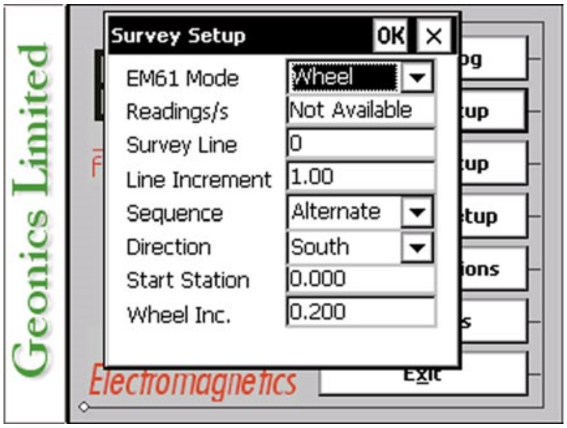
3.1 Set up the EM61 for fiducial mode

The following steps are followed to begin surveying with the EM61-MK2 with fiducial positioning:
1. Turn on the EM61-MK2 by pushing in the fuse on the top of the console/electronics.
2. Allow the instrument to warm up for at least 15 minutes.
3. Turn on the Allegro CX (or similar field computer) and open the EM61MK2 program. The screen below will be displayed.

4. Click on “Survey Setup” and specify the following options. Depending on surface conditions, the Mode is set to “Auto” and Readings/s is set to “10” or the Mode is set to “Wheel”, Readings/s to “Not Available”, and Wheel Inc. to 0.2. The remaining options become important for maintaining positioning.

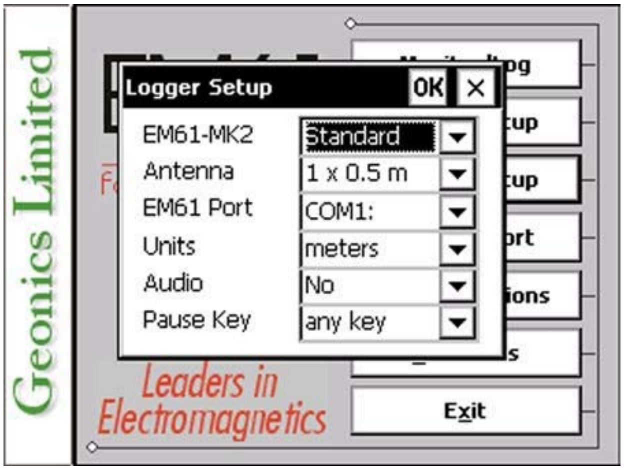


EM61 Mode	Auto
Readings/s	5.00
Survey Line	0
Line Increment	1.00
Sequence	Alternate
Direction	South
Start Station	0.000
Stn Increment	1.000



EM61 Mode	Wheel
Readings/s	Not Available
Survey Line	0
Line Increment	1.00
Sequence	Alternate
Direction	South
Start Station	0.000
Wheel Inc.	0.200

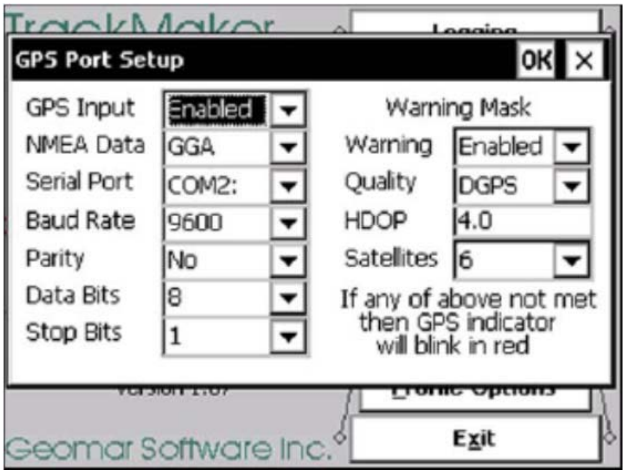
5. Click on “Logger Setup” and specify the following options. These settings will remain as defaults throughout the project.



Logger Setup OK ×

EM61-MK2	Standard
Antenna	1 x 0.5 m
EM61 Port	COM1:
Units	meters
Audio	No
Pause Key	any key

6. Click on “GPS Port Setup”, and make sure the GPS Input is set to “Disabled”, and all other options are grayed out.



GPS Port Setup OK ×

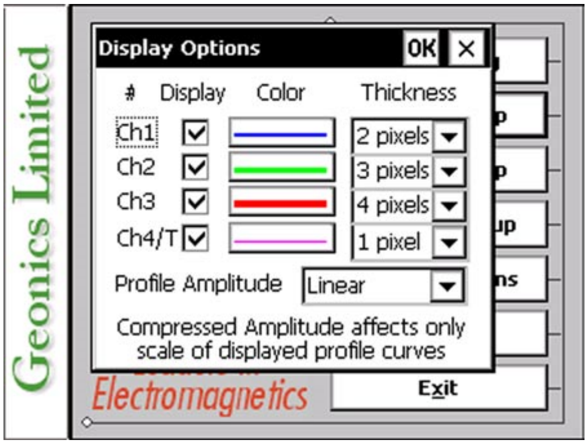
GPS Input	Enabled
NMEA Data	GGA
Serial Port	COM2:
Baud Rate	9600
Parity	No
Data Bits	8
Stop Bits	1

Warning Mask

Warning	Enabled
Quality	DGPS
HDOP	4.0
Satellites	6

If any of above not met then GPS indicator will blink in red

7. Click on “Display Options” and specify the following options. These options are also operator preferences for aesthetics and do not affect the collected data.



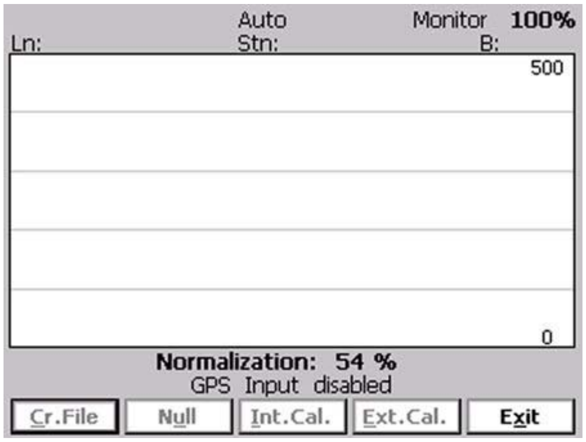
Display Options

#	Display	Color	Thickness
Ch1	☑	🟦	2 pixels
Ch2	☑	🟩	3 pixels
Ch3	☑	🟥	4 pixels
Ch4/T	☑	🟪	1 pixel

Profile Amplitude: Linear

Compressed Amplitude affects only scale of displayed profile curves

8. Once all parameters are set, click on “Monitor/Log”. The screens shown below are displayed while the instrument is normalizing.



Ln:

Auto Stn:

Monitor 100% B:

Normalization: 54 %

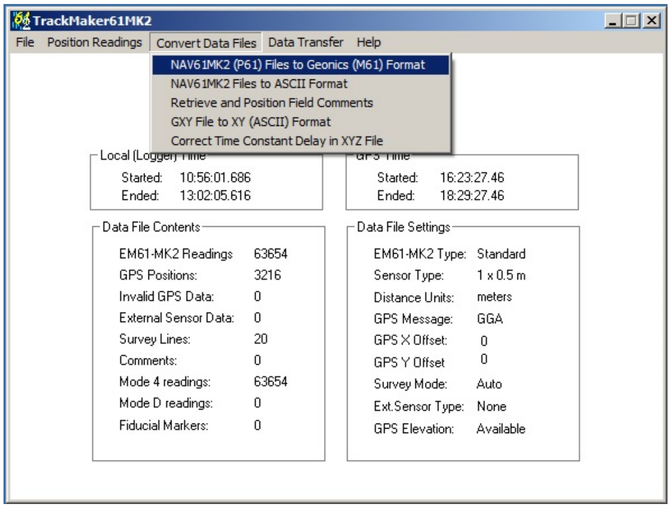
GPS Input disabled

9. Line up on the grid or transect and select Go. The software will begin logging the readings, and a Pause button will appear at the bottom of the screen. As the operator crosses over each rope (reference location) the fiducial button is hit adding a marker in the data which is later used in the editing of the data to accurately position the data. At the end of the line, tap the Pause button or hit enter on the keypad.

3.2 Editing fiducial data

In the case of fiducial mode, positional data are edited based on the known locations of line ends and fiducial marks. The following steps are used to convert EM61-MK2 cart mode data with fiducial positioning to .xyz files:

1. Go to “File” – Open file – Browse and select the *.p61 file
2. Go to “Convert Data Files” and select “NAV61MK2 (P61) Files to Geonics (M61) Format”



Local (Logger) Time
Started: 10:56:01.686
Ended: 13:02:05.616

GPS Time
Started: 16:23:27.46
Ended: 18:29:27.46

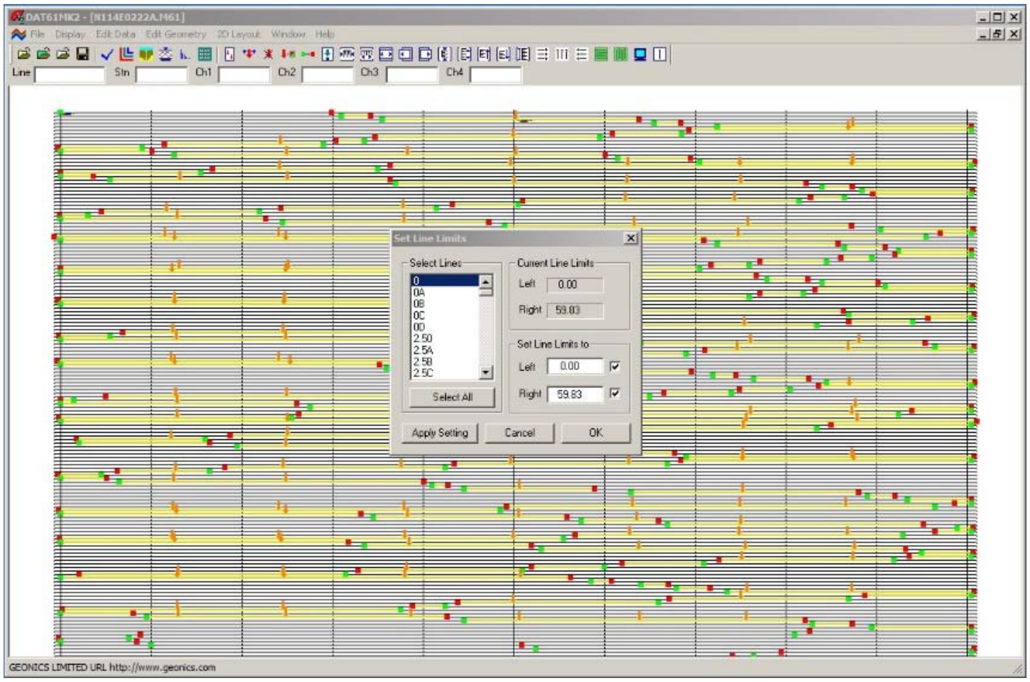
Data File Contents
EM61-MK2 Readings: 63654
GPS Positions: 3216
Invalid GPS Data: 0
External Sensor Data: 0
Survey Lines: 20
Comments: 0
Mode 4 readings: 63654
Mode D readings: 0
Fiducial Markers: 0

Data File Settings
EM61-MK2 Type: Standard
Sensor Type: 1 x 0.5 m
Distance Units: meters
GPS Message: GGA
GPS X Offset: 0
GPS Y Offset: 0
Survey Mode: Auto
Ext.Sensor Type: None
GPS Elevation: Available

3. Editing of fiducial markers/end points and creation of Geosoft xyz data files is performed in DAT61MK2

4. Got to “File” – “Open Profile File” – Browse and select the *.m61 file

5. To edit the end points, go to “Edit Geometry” – “Set Line Limits” and the following screen will appear

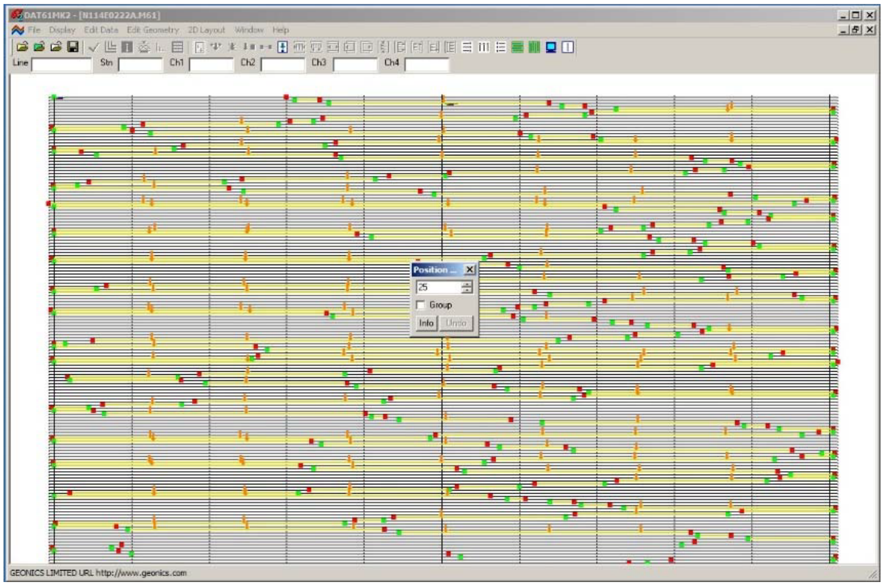


Current Line Limits
Left 0.00
Right 59.83

Set Line Limits to
Left 0.00 ☑
Right 59.83 ☑

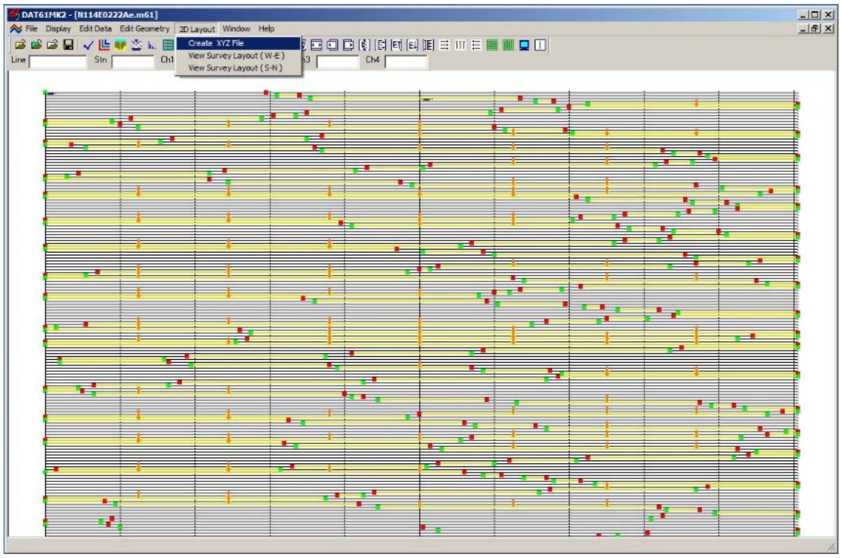
o Select a line of data and edit the appropriate end point in the “Set Line Limits to” box
o Click “Apply Setting” and move to the next line of data until all lines have been edited
o Click “OK”

6. To edit the fiducial marks, go to “Edit Geometry” – “Position Markers” and the following screen will appear

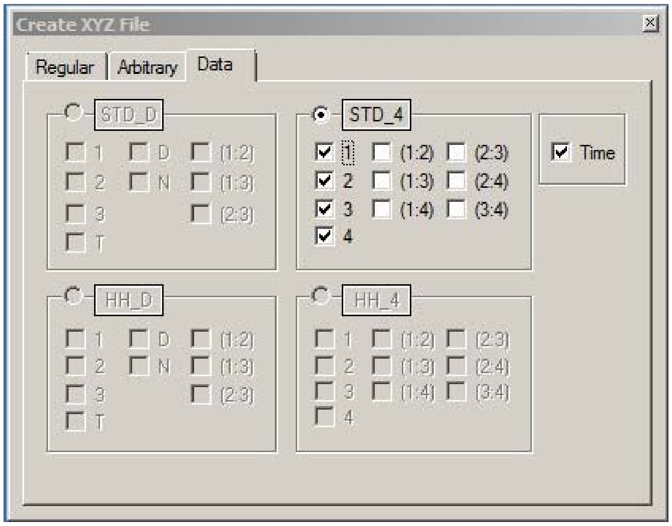


o Enter the value of the first fiducial mark to edit and click on each mark with that position, or:
o Enter the value of the first fiducial mark to edit, click on the “Group” check box, and draw a box around each mark with that positing
o Continue until all fiducial marks have been edited close the Positioning dialog box

7. Go to “File” – “Save As…” and save the edited file using the same name as the raw file but with an “e” appended to the end
8. To create the Geosoft XYZ file
o Go to “2D Layout” and select “Create XYZ File”

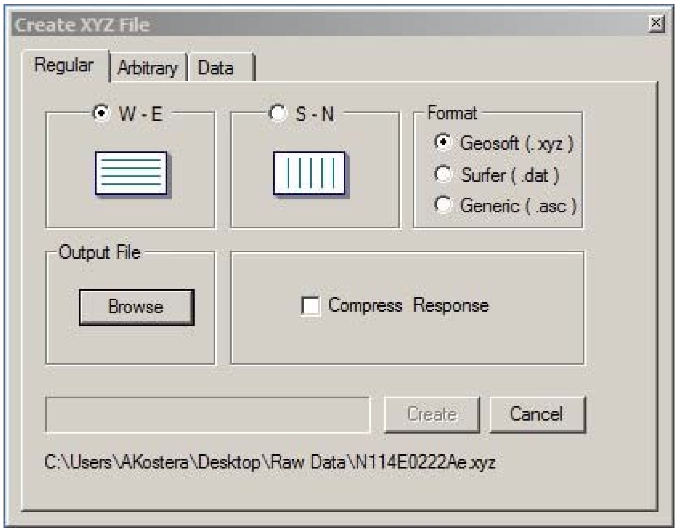


o On the “Data” tab, select the settings shown below



● STD_4
☑ 1
☑ 2
☑ 3
☑ 4
☑ Time

o On the “Regular” tab select either “W – E” or “N – S” as appropriate for the direction of data collection, browse for the Output File name and click “Create.”



● W - E
● Geosoft (.xyz)
☐ Compress Response

C:\Users\AKostera\Desktop\Raw Data\N114E0222Ae.xyz

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	11/26/19	Initial release for AECOM MMRP.	All

SOP GEO-2a: Assemble EM61 and Verify Correct Operation

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when assembling the Geonics EM61-MK2 (EM61) sensor system for person-portable data collection and verifying that components are correctly assembled, operating normally, and capable of acquiring data of sufficient quality.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

The following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist: Confirms that sensor was assembled correctly, either in person or through review of notes, photographs, and QC checklist.

- Site Geophysicist: Confirms that sensor was assembled correctly. May operate geophysical sensor during data collection or provide oversite of data collection team.

- QC Geophysicist: Reviews QC testing results and verifies results are documented in the QC database.

- Data Processor: Processes collected data and documents QC results in the project QC database.

- Field Team Lead (FTL) /Member: Operates geophysical sensor during data collection. The FTL will be responsible for sending daily data, field notes, and photos to the data processor.

2.2 Equipment and Materials

The following is a list of required equipment and materials:

EM61: The EM61 sensor system will be used to provide data for Digital Geophysical Mapping activities.

Positioning system: This SOP assumes that positioning will be based on RTK GPS, using corrections from a local base station or over the cellular phone network. The EM61 can also be operated without a positioning system, e.g., using the fiducial method (see SOP GEO-1c) or with a Robotic Total Station (see SOP GEO-1b).

Field note book: Notes will be taken to record relevant information.

Camera: A digital camera will be used to document activities if necessary.

3. Procedures and Guidelines

3.1 EM61 assembly

The field geophysicist will assemble the EM61 according to the procedures described in the EM61 user manual. Use of the top coil is subject to the preference of the Project Geophysicist, and/or style of GPS mounting tripod which will attach either to the top or bottom coil. System assembly will vary depending on whether wheeled or litter mode is employed.

3.2 EM61 Verify Correct Operation

Verify the GPS output is functioning and sending the proper NMEA stream by viewing the GPS monitoring as described in the EM61 user manual. Verify cable connections by performing cable shake test. This is performed by monitoring the EM61 output while gently moving cables. Spikes in the data indicate a short or broken pin in the connector. Systematically test all cables.

4. Data Management

Input data required: The EM61 user manual and Operational Procedures and Quality Control Recommendations (Geonics) provides all assembly and testing steps required by this SOP.

Output data required: The assembly and verification procedure include two tests, but results are observational only and no data is recorded.

5. Quality Control

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly instructions have been followed.

6. Reporting

The delivered data package for the assembled and tested EM61 will be included in a section of the IVS Letter Report, if applicable. The IVS Letter Report will include:

- Brief description of the assembly and test process

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/13/19	Initial release for AECOM MMRP.	All

SOP GEO-3: Test Sensor and System at the IVS with EM61

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the means and methods to be employed when verifying the operation of a Geonics EM61-MK2 High Sensitivity Metal Detector (EM61) sensor system prior to and during site surveys. The instrument verification strip (IVS) is constructed of a series of buried inert munitions or industry standard objects (ISOs). During the IVS process the EM61 measures the response of each item in the IVS and these responses are compared to theoretical and average expected responses to ensure and document proper functioning of the system. Execution of the IVS mapping will be consistent with the Geophysical System Verification approach defined in the DoD's Environmental Security Technology Certification Program (ESTCP) report: Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response (2009).

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

UXO escort: Conducts MEC escort and anomaly avoidance activities, as needed, during IVS construction and testing. Must be a qualified UXO Technician II or higher.

At least two of the following geophysicists will be involved in verifying correct operation of the EM61 at the IVS. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

Project Geophysicist: Designs IVS and reviews IVS testing results; responsible for production of IVS Technical Memorandum.

QC Geophysicist: Reviews IVS testing results and verifies IVS results are documented in the QC database.

Field Geophysicist: Documents IVS seed data (position, depth, type) and operates geophysical and positioning equipment over the IVS and noise strip.

Data Processor (geophysicist): Processes IVS data and documents results in the QC database.

Note: With the exception of the QC Geophysicist, multiple roles may be performed by a single geophysicist (e.g. the Project Geophysicist may also perform the roles of Field Geophysicist and Data Processor).

2.2 Equipment and Materials

The following is a list of required equipment and materials:

- EM61 sensor coupled with a real-time kinematic (RTK) global positioning system (GPS)

- Seed items to construct the IVS (e.g., inert munitions, Schedule 40 small ISOs [small ISO40], Schedule 80 small ISOs [small ISO80], Schedule 40 medium ISOs [medium ISO40], Schedule 40 large ISOs [large ISO40])
- Meter stick or sturdy measuring tape to measure the depth of the seeded items
- Non-metallic markers (e.g., pin flags, stakes, tent pegs, spray paint, ropes, flagging) to mark the positions of the test items and the beginning and end of the IVS
- Hand tools, including a shovel (optional: pick axes, breaker bars, etc., as necessary), to construct the IVS
- Camera to take photos of ISO installation and overall IVS

3. Procedures and Guidelines

3.1 Instrument Verification Strip Construction

Verification of the digital geophysical mapping (DGM) system is accomplished using an IVS. Multiple IVS locations may be constructed during the project for convenience (for example, to avoid long travel times to reach the work area on large sites). The construction details and verification procedures described in this document apply to each IVS location.

3.1.1 Location and Configuration of the IVS

IVS locations will be determined during initial site reconnaissance by the DGM field team. The IVS should be established in an area that is easily accessible, not prone to flooding and other weather related phenomena, and is determined to be relatively free of subsurface metal objects. An IVS location will be selected with preference for the following (although not all the conditions are vital for the IVS):

- Terrain, geology and vegetation similar to the area for which the IVS test is designed
- Geophysical noise conditions similar to those expected across the survey area
- Large enough area to accommodate all equipment and to provide at least 2-m separation between buried test items to avoid ambiguities in data evaluation
- Readily accessible to personnel
- Close proximity to, or within, survey site
- Open access to satellite signals and adequate RTK radio reception if using RTK positioning

3.1.2 IVS objects

ISOs or inert munitions serve as test items that are seeded in the IVS. Inert munitions that match those expected at the site are preferable to demonstrate to stakeholders that the system is able to accurately detect the exact MEC of concern. However, using ISOs is the technical equivalent and extraordinary measures to obtain inert munitions are not warranted. ISOs, if used, should approximate the size of the MEC expected to be found on the site. Small, medium, or large ISOs, singly or in combination, can be selected. Table 1 shows the specifications for the four sizes of ISOs. If Advanced Geophysical Classification (AGC) using an advanced EMI sensor will be performed as a part of this effort, the schedule 80 small ISO must be used if a small ISO is used, otherwise the schedule 40 is acceptable.

Table 1: Industry Standard Object specifications.

Item	Pipe size	Outside diameter	Length	Part number(1)	Schedule
Small ISO40	25 mm (1")	33 mm	102 mm	44615K466	40
Small ISO80	25 mm (1")	33 mm	102 mm	4550K226	80
Medium ISO40	51 mm (2")	60 mm	204 mm	44615K529	40
Large ISO40	102 mm (4")	115 mm	306 mm	44615K137	40

(1) Part number from the McMaster-Carr catalog (http://www.mcmaster.com/).

3.2 IVS Setup Procedures

Exhibit 1 illustrates the overall IVS process and the procedures to be followed during the siting, emplacement, and use of the IVS.

3.2.1 IVS Background Survey

The Field Team Leader will perform a background DGM survey with a fully operational EM61 system with positioning capability. The purpose of this step is to document the appropriateness of the location (e.g. few existing anomalies) and verify that IVS targets would not be seeded near existing anomalies. The data from this IVS pre-survey will be evaluated before any seeding is performed. If subsurface anomaly sources are too numerous to facilitate a “clean” IVS, they must be removed, or an alternative location must be identified. Intrusive removal may only be achieved when the appropriate personnel are on site (i.e., SUXOS, UXOSO, etc.) and available to approve intrusive activities and assign personnel to the task. Geophysical personnel may not remove subsurface metal from a proposed IVS location.

3.2.2 IVS Test Item Location Selection

Once the IVS area is deemed suitable for use, (i.e. free of significant subsurface anomalies or containing anomalies that are clearly identified so that they can be removed or avoided during seeding), targets will be buried at a depth that provide adequate signal to noise ratio. The targets will be buried along a straight line in a due north-south or east-west orientation, with at least 2-meter separation, if site conditions allow, so that signals from buried items do not overlap.

3.2.3 IVS Test Item Burial and Metadata Recording

Measurements of the item depths will be to the center of mass of each item. If needed, the UXO escort will implement MEC avoidance procedures in accordance with project specific safety documentation. The following information will be recorded for each IVS test item:

- The IVS transect endpoints;
- Test item description (e.g. Small ISO80);
- Test item location;
- Test item depth to the center of mass;

- Test item inclination (e.g. horizontal, vertical, degrees [0 is horizontal, 90 is vertical]);
- Test item orientation (e.g. N-S, E-W, inline, Degrees 0-360 [0 is North]);
- Photograph of the emplaced test item with ruler visible showing the depth of the item;

2. Holes will be backfilled once the appropriate data have been recorded. Non-metallic markers (e.g., pin flags, stakes, tent pegs, spray paint, ropes, flagging) will mark the positions of the test items and the beginning and end of the IVS.
3. A second transect will be free of anomalies and will have no seed items and will be used to determine the background noise levels of the site. The transect end points will be similarly marked as the unseeded line.

3.3 IVS Data Collection Procedures

At the start and end of each production day (if circumstances permit), data will be collected over the IVS with the EM61 sensor:

- To establish initial IVS MQO's, a series of 5 passes directly over the IVS targets will be collected.
- Offset line(s) data will be collected at one half the design line spacing for the initial IVS collection only.
- For daily IVS measurements, a minimum of two lines will be acquired in opposite directions along a line that passes directly over each seed item**.** It is critical to maintain a consistent sensor height and walking speed during acquisition of IVS data. This ensures that the IVS data amplitude and positioning MQOs can be met.
- Similarly, the background track will be acquired in opposite directions.

3.4 IVS Data Processing Procedures

The raw data files will be sent to the data processor who will perform the following steps for each of the IVS tests.

1. Import data
2. Filter EM61 data to remove background response and apply latency correction
3. Select peak response of seeded items
4. Verify that all IVS MQOs specified in the QAPP are met
5. Record results of IVS tests in project QC database
6. If any MQO is not met, notify the responsible person and initiate a failure response, as designated in the QAPP

4. Data Management

The following sections describe the data that are needed to perform the procedures in this SOP and the resulting data deliverables.

4.1 Input data

Input data required for this SOP are the IVS ground truth, initial EM61 IVS measurements, and ongoing IVS measurements.

4.2 Output data

Performance and acceptability of the initial IVS data will be documented in an IVS Technical Memorandum. The results of the ongoing IVS testing will be saved in the project database.

5. Quality Control

This definable feature of work (DFW) is performed throughout the project. IVS measurements will be made each day prior to collecting field data, and, except if there is an instrument malfunction, weather related issue or some other event that prohibits collection, each evening after field data collection. Performance of the required QC checks will be documented by the QC or Project Geophysicist in the project database, which will be updated daily. The failure response specified in the QAPP will be followed for any IVS MQO that is not satisfied.

6. Reporting

IVS construction, implementation, and results relative to established MQOs (Worksheet 22) will be documented in an IVS Letter Report. The IVS Letter Report will include:

- A description of the IVS as-built
- Results of the mapped responses and comparisons to expected theoretical responses
- Proposed target selection criteria

Daily IVS results will be maintained in the project database, which will be updated daily. The database will be included with weekly data deliverables or upon request and will also be included with the Final Report.

7. Exhibits

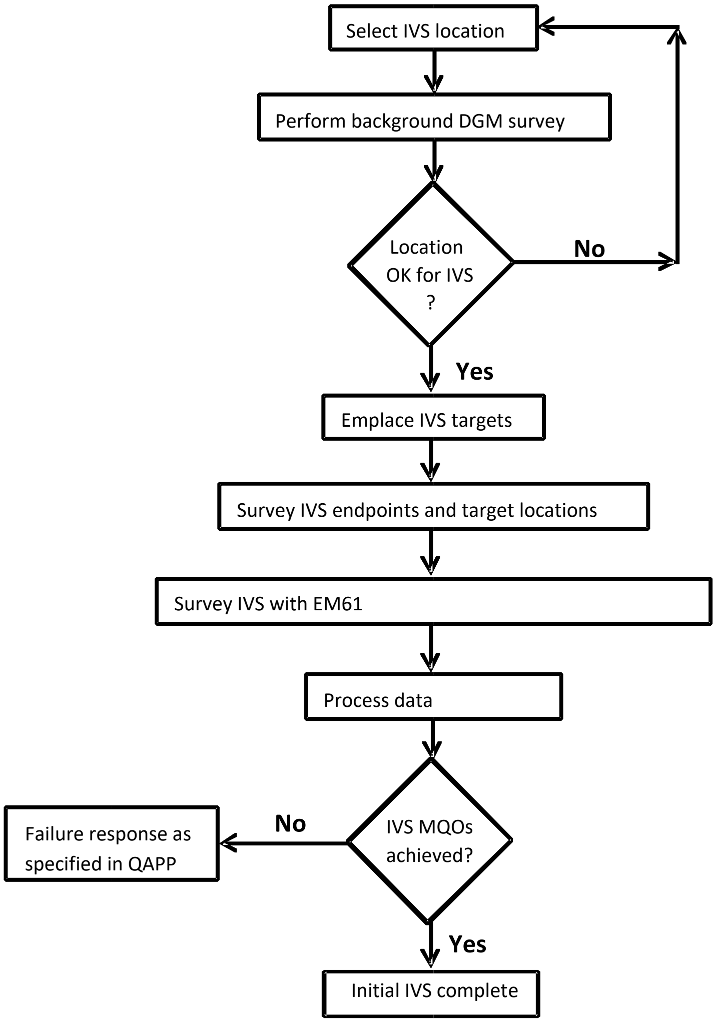


Exhibit 1: Flowchart for establishing and using an IVS.

8. References

ESTCP. 2015. Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response (Addendum). September.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/04/19	Initial release for AECOM MMRP.	All

SOP GEO-4: Production Area Seeding

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when emplacing QC seeds in the production area.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

The following individuals will be involved in production area seeding. The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7, and 8.

- QC Geophysicist
- UXOQCS

UXO Personnel will be responsible for overall daily site access and safety aspects of the project, compiling subcontractor health and safety documents, conducting daily safety briefings and performing munitions and explosives of concern (MEC) avoidance, as needed, in the field.

2.2 Equipment and Materials

The following is a list of required equipment and materials:

- Seed items (e.g., inert munitions, Schedule 40 small ISOs [small ISO40], Schedule 80 small ISOs [small ISO80], Schedule 40 medium ISOs [medium ISO40], Schedule 40 large ISOs [large ISO40])
- Paint pen or tape (e.g., duct tape) and a permanent marker for labeling each seed item, if necessary
- Handheld geophysical sensor (e.g., Schonstedt magnetic locator or White's metal detector)
- Hand tools, including shovel (optional: pick axes, breaker bars, etc., if necessary), to emplace the seeds
- RTK GPS unit to record the location of seed items
- Measuring tape and straight edge to measure the depth of the seeded items
- Level or inclinometer and compass to measure the inclination and orientation of the seeded items, if necessary

3. Procedures and Guidelines

The production area seed plan provides a list of seed identities, locations, depths, and orientations. When emplacing the seeds, the emplacement team should employ anomaly avoidance techniques as described in Section 3.1 and use the emplacement procedure described in Section 3.2.

3.1 Anomaly Avoidance

It is likely that the production area will contain metallic items and/or electromagnetically active geology that will produce anomalies in data collected with a magnetometer or electromagnetic induction instrument. The emplacement team should avoid emplacing seeds in the immediate vicinity of any significant anomalies. Figure 1 describes the process that should be used to avoid strong anomalies when emplacing a seed. First, the emplacement team should identify the seed's intended location. Then, the team should use a handheld instrument to survey within the immediate vicinity (60 centimeter [cm] to 80 cm radius) of the intended location. If there are no significant anomalies in the immediate vicinity, then the team should emplace the seed at the intended location. If, however, the intended location is in the immediate vicinity of any significant anomaly, then the team should select a new location for the seed. The new location should ***not*** be within the immediate vicinity of any significant anomaly and should ***not*** be within 60 cm of another seed.

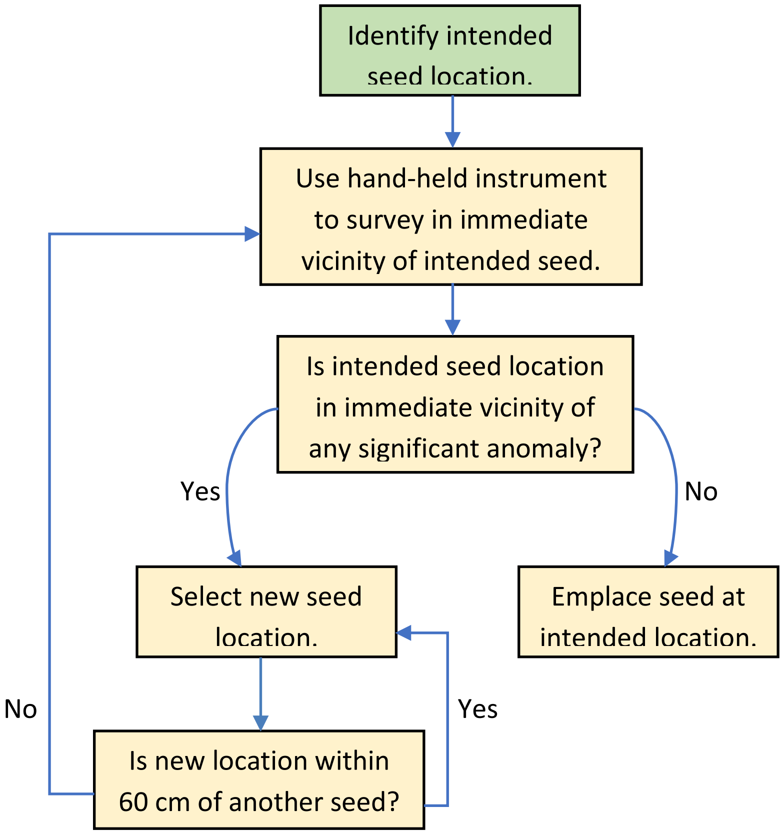


Figure 1: Anomaly Avoidance During Seed Emplacement

3.2 Seed Emplacement

It is critical for the success of the study that the ***actual locations*** of the buried seeds are surveyed as accurately and precisely as possible. To that end, the emplacement team should dig in a manner that minimizes seed migration (e.g., settling) after burial.

After emplacing a seed in the ground, but before covering it with soil, the following information should be carefully recorded:

- X and Y coordinates for the center of the seed, with coordinates reported per the project specific QAPP.
- Depth of the seed from the ground surface, which should be measured as the vertical distance from the bottom of a straight edge placed across the opening of the hole down to the center of the seed. The emplacement team should adjust the depth and inclination angles of the seeds to ensure 5 cm of overburden.
- Photograph of the seed, showing its serial number; a ruler or similar scale should also be included in the photograph.

For each seed, the emplacement team should also:

- Replace soil in the hole as completely as possible.
- Level the burial location.
- Replace the grass plug over the burial location (if present).

4. Data Management

The following sections describe the data that are needed to perform this SOP and the resulting data.

4.1 Input Data Required

None required.

4.2 Output Data

The final Production Area Seed Log is the output data from this SOP. This log consists of a seed location table that includes the “as emplaced” identity, location, depth, and orientation of each of the emplaced seeds accompanied by a photograph of the item in the ground before being covered.

4.3 Blind Seed Firewall

Only specific project personnel are allowed to have knowledge and access to the QC seed information to ensure the integrity of the data collection, processing, and analysis efforts. Personnel involved in data collection, processing and removal activities on the project will be prevented from having access to information related to the detailed information for the QC seeds. The information will be provided to them only as needed for post-dig analyses, such as a root-cause analysis (RCA). Transfer of QC blind seed data may occur as email attachments or directly to a protected network drive. The information and data will be stored only on local hard drives of the PCs assigned to the individuals within the quality program and independent of operations or in a protected folder on the file server accessible only to the staff listed above and the server administrator.

5. Quality Control

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that all seeds have been emplaced with the specified precision. No field work will be performed until this has been documented as described below.

6. Reporting

The seed log maintained by the QC Geophysicist comprises the required reporting.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP	All

SOP GEO-4, Attachment 1: Preparatory Production Area Seeding QC Checklist

This checklist is to be completed by the QC Geophysicist following completion of production area seeding.

QC Step	QC Process and Guidance Reference	Yes/No	Initial
1. Preparation	Have appropriate production area seed items been selected and procured?		
2. Seed Emplacement	Were the target seeds buried appropriately, measured, photographed, and backfilled?		

QC Geophysicist: ______________________________________Date: ___________________

SOP GEO-4, Attachment 2: Blind Seed Log

This table is to be completed by the QC Geophysicist following completion of production area seeding.

Grid	Date Seeded	SeedID	Easting	Northing	Depth to Center (cm)	Orientation	Azimuth	ISO Size	X_target	Y_target	Offset (cm)	Recovery Date	Recovery Team	Notes

SOP GEO-5a: Perform Dynamic Surveys with EM61 cart

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when performing dynamic surveys using the Geonics EM61-MK2 (EM61) sensor system in the person-portable configuration. It follows industry guidelines and provides details of the approach, methods, and operational procedures to be employed during performance of Digital Geophysical Mapping (DGM). Project specific geophysical performance and quality control parameters are outlined in the QAPP Worksheet 22.

Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

1.1 Personnel

The following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist: Confirms that sensor was assembled correctly, either in person or through review of notes, photographs, and QC checklist.

- QC Geophysicist: Reviews QC testing results and verifies results are documented in the QC database. Reviews production data to ensure all blind seeds are successfully detected and targeted.

- Data Processor: Processes collected data and documents QC results in the project QC database.

- Field Team Lead (FTL) /Member: Operates geophysical sensor during data collection. The FTL will be responsible for sending daily data, field notes, and photos to the data processor.

1.2 Equipment and Materials

The following is a list of required equipment and materials:

EM61: The EM61 sensor system will be used to provide data for Digital Geophysical Mapping activities.

Positioning system: This SOP assumes that navigation will be based on RTK GPS, using corrections from a local base station or over the cellular phone network. The EM61 can also be operated without a positioning system, e.g., using the fiducial method.

Field note book: Notes will be taken to record relevant information.

Camera: A digital camera will be used to document activities if necessary.

2. Procedures and Guidelines

2.1 Assemble and test the EM61

The field geophysicist will assemble and test the EM61 according to SOP GEO-2a.

2.2 Data Collection

To ensure that the instrumentation can attain the required measure of performance, geophysical system verification (GSV) will be conducted throughout field activities. As part of the GSV, an IVS will be geophysically mapped prior to any geophysical surveying to verify system performance and establish expected levels for background noise. Execution of the IVS mapping will be consistent with the GSV approach defined in the Department of Defense's (DoD's) Environmental Security Technology Certification Program (ESTCP) report: Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response (2009). For details on the IVS installation and data collection, see SOP GEO-3.

2.2.1 Daily Tests

The following QC procedures will be performed and documented as part of DGM field procedures. QC tests will be combined in a digital project QC file with unique identifiers for day and time. Refer to the project QAPP for required equipment tests, frequencies of testing, and description of each test. Unless stated differently in the QAPP, the daily test routine is as follows:

At start of day, after a 15-minute instrument warm-up, the morning test will include:

1. A minimum 3 minute static background collection, then 1 minute with a known source, followed by an additional 1 minute of static background collection
2. A cable shake test
3. Personnel test
4. IVS and noise survey
5. The evening static background test will consist of 1 minute of static background data collection, followed by 1 minute with a known source, followed by 1 minute of static background.

2.2.2 Logbook Entries

One member of the team will be responsible for maintaining the logbook. Record the following information in the logbook:

- Investigation area (digital or hardcopy form)
- Sketch of location if necessary to document anomalous site conditions (hardcopy)
- Time and date survey started (digital or hardcopy form)
- Names of team members (digital or hardcopy form)
- Weather conditions (digital or hardcopy form)
- Serial numbers of GPS rover unit and geophysical instrumentation (digital or hardcopy form)
- Obstacles preventing completion of DGM survey as planned (digital or hardcopy form)
- Issues identified with the system that might impact data quality (digital or hardcopy form)

2.2.3 Data Files

A unique data file will be started for each of the following events:

- Static/ Cable/ Personnel test
- Each time the IVS is performed
- When data acquisition is started in a new area
- When the system is powered-off and back on, including battery swaps[1]
- Each time an issue with the system that could have a significant impact on data quality is identified and corrected (loose wheel, loose cable, metal caught on system, etc.).

Files will be named on the field computer using the date in a MMDDYY format, followed by a sequential letter, and the team number. For January 31, 2018 Team 2, the first file name would be “013118a2,” and the second file would be “013118b2.” Teams should avoid generating large numbers of files outside of the events listed above, to reduce the effort in later data processing. Daily Checks should be labeled with an identifier indicating the type of check, followed by the date and an ‘a’ for AM or ‘p’ for PM, as applicable for twice daily checks. For example, the AM IVS check on January 31, 2018 should be labeled “IVS013118a2.”

<u>Prefixes:</u>
CAB for cable shake
PER for personnel test
SIX for six line test
STA for static test
BCK for background strip
IVS for IVS strip

2.3 Survey Methods

2.3.1 Transect Survey

Transect surveys consist of geophysical detection equipment pulled along a single meandering or straight line parallel to a set of lines spaced at regular intervals. The transect surveys may be used to find MEC or evidence of MEC, determine MEC anomaly density, and to delineate target areas. Results from transect surveys can also be used to delineate and select areas for further investigation using complete grid surveys, if required.

Transect spacing will be determined by the scope of work, site-specific history, and physical features of the site. The resultant DGM field data, combined with archival and anecdotal information, will be used to make determinations of specific source areas (e.g., impact area, burial area, etc.).

2.3.2 Complete Coverage Grid Survey

A complete grid survey is defined as multiple transects within a grid with spacing less than the width of the detector equipment sensor swath (effective area imaged by the sensor). Generally,

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[1] EM61 batteries will be swapped out before battery voltage drops below 11.0 volts

an area will be divided into grids as determined in the project QAPP, where complete geophysical coverage of the electromagnetic signature will be performed to discover electromagnetic anomalies associated with MEC. The primary method of deployment for complete grid surveys will be the EM61 using parallel transect surveys with spacing requirements identified in the project QAPP.

Survey lanes will be clearly marked using rope, foam, paint, cones, or other suitable navigation aid except where the terrain clearly records the wheel mark of the cart (e.g., loose soil). Areas within established grids that cannot be mapped because of terrain and impediments such as vegetation or fences will be noted in the geophysical logbook.

2.3.3 Deviation from Planned Survey Orientation and Spacing

During the geophysical surveys of transects and grids, there are instances when the field team encounters obstacles such as large rocks, ditches and ravines, fences, utility signs, etc. It is important to record the type of feature encountered and the location so that it can be accounted for during the data interpretation phase. The FTL will be responsible for determining whether an area is considered inaccessible. The following steps are recommended to perform transect deviation documentation:

- When performing complete coverage grid survey mapping, the inaccessible area will be “traced” with the survey equipment whenever possible. Alternatively inaccessible areas, obstructions and cultural features may be delineated with GPS.
- The area of deviation will also be noted on a map to the extent possible.

2.4 Positioning System

DGM data will be integrated with a positioning system with the preferred method of survey grade real-time kinematic (RTK) global positioning system (GPS), Virtual Reference Station (VRS) GPS or satellite-based L-band correction to record accurate positional data for the EM61-MK2 sensor(s) during data collection. See SOP GEO-1a for procedures for the RTK positioning system. If site conditions necessitate a Robotic Total Station (RTS), refer to SOP GEO-1b. In person-portable configurations, the GPS rover will be mounted on a tripod directly over the EM61-MK2 sensor and interfaced with the data logger to record positional data coincident with instrument readings. The positional data will be recorded at a rate of one (1) Hertz (Hz).
DGM surveys may need to be conducted in wooded areas where no GPS is available because of tree cover and the use of Robotic Total Station (RTS) equipment is not practical. In this instance, the equipment operator will collect DGM data in fiducial mode, whereby each transect is started at a known surveyed coordinate and is continued in a straight line until a second surveyed coordinated is reached. The data will be registered based on a fiducial spacing set at intervals as recorded by the geophysical instrument involved. The data will then be interpolated to spatially rectify the data. Refer to SOP GEO-1c.

2.5 Photographs

Digital photographs will also be used to document site conditions. Each team will maintain a photo log in their field logbook. The date, time, and subject of each photograph will be recorded at the time the photograph is taken. The digital cameras and copies of the photo logs will be turned in daily with field long entries.

3. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data deliverables.

3.1 Input data

The data inputs required for performing dynamic data acquisition are:

- A list of coordinates identifying the site boundaries;
- Instrument verification strip (IVS) transect start and end points.

3.2 Output data

The data outputs are:

- IVS and QC test measurement data;
- EM61 data over the survey area;
- Raw field notes (pdf or jpg images of hand-written notes);
- If applicable, digital field notes (MS Access, MS Excel or other digitally recorded table presenting data filenames as delivered and rectified field notes, i.e. with differences between delivered digital filenames and field notes resolved).

4. Quality Control

Quantitative QC and assessment of the collected data will be performed as part of SOP GEO-6 dealing with the processing of EM61 data. QC results for MQOs specific to the collection and processing of EM61 data (function and IVS testing, in-line measurement spacing, coverage; Worksheet 22) will be recorded in the project database. The database will be included with weekly data deliveries or delivered upon request.

The MQOs for EM61 data collection are presented in Worksheet #22 of the QAPP. Performance relative to the MQOs will be assessed during the processing of the collected data.

5. Reporting

Reporting of the activities associated with this SOP will consist of the digital copies of the field notes and the project QC database.

6. References

ESTCP. 2009. Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response. August.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	02/08/19	Initial release for AECOM MMRP.	All

SOP GEO-6: Process Dynamic Survey Data with EM61

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when processing data collected using the Geonics EM61-MK2 (EM61) sensor system. This SOP will ensure data processing conforms to industry standards and will be consistently implemented.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

The following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist: Confirms that sensor was assembled correctly, either in person or through review of notes and photographs.

- QC Geophysicist: Reviews QC testing results and verifies results are documented in the QC database. Reviews production data to ensure all blind seeds are successfully detected and targeted and date meets the MQOs documented in QAPP Worksheet #22.

- Data Processor: Processes collected data and documents QC results in the project QC database.

2.2 Equipment and Materials

The following is a list of required equipment and materials:

Data Processing Computer: computer able to perform the data processing steps, with the appropriate software: Geosoft Oasis Montaj including the UX Land module, and software to convert the binary field data to xyz data (dependent on data collection method and software provided by EM61 vendor).

3. Procedures and Guidelines

3.1 Data Import, Corrections and Leveling

1. Convert file from *.r61, *.n61, or *.m61 format and assign coordinates using Dat61mk2 or Trackmaker61 if data were recorded on a handheld data logger or Magmap or Multi61 if data were recorded using Maglog or ML61, respectively.
2. Import ASCII files into Geosoft database.
3. Correct for latency using Geosoft UX Land module latency correction GX based on latency observed in daily IVS.
4. Run script for coordinate conversion, leveling, and gridding.
5. Verify QC tests meet MQOs

6. Check background noise, velocity, coverage, and downline spacing to prepare deliverables and ensure MQOs are met.
7. Verify if any grids or areas have been completed and are ready for target selection.

3.2 Target picking

1. Run target picking script and review target list. Merge targets with merge radius depending on project objectives:
    a. For a dig list the merge radius is typically set to be slightly smaller than the dig radius. This will mitigate merging of two distinct targets in close proximity. The data processor will review larger footprint anomalies and create separate targets as necessary.
    b. For dynamic survey data that will be used to support an Advanced Geophysical Sensor Cued Survey, a small merge radius will be used, and special care will be taken to ensure individual targets are not missed. The merge radius will be set to a maximum of 25 cm.
2. Identify potential “mag and dig” areas (e.g. spatially-extended anomalies).
3. Following QC approval, deliver target list to dig team(s) when applicable.
4. Export data and anomaly selections for delivery to client and import into project database.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data deliverables.

4.1 Input data

The data inputs required for processing dynamic data are:

- A list of coordinates identifying the site boundaries.
- Raw EM61 files, including field data, IVS data, and QC test data.
- Digital copies of field notes for all data collection activities.
- Amplitude response minimum detection thresholds.

4.2 Output data

The data outputs are:

- Weekly QC reports and a project database summarizing daily QC measurement results
- Processed EM61 files
- Target anomaly list (identifier [ID], X, Y)
- Geosoft grids
- Geosoft databases (.gdbs)
- Geosoft maps
- Polygon files of grid corners, obstructions, and mag and dig areas

5. Quality Control

QC results for MQOs specific to the processing of EM61 data (function and IVS testing, in-line measurement spacing, coverage; as presented in Worksheet 22 of the QAPP) will be recorded in the project database. Performance relative to the MQOs will be assessed during the processing of the data. The database will be included with weekly data deliveries or delivered upon request.

6. Reporting

Final processed data will be produced and presented in ASCII formatted files and in native Geosoft format (.gdb). Final processed data will have corrections applied that are needed to correct for positioning offsets, instrument bias (including instrument latency), and instrument drift. Corrections and processing steps will be documented. Metadata for final processed and advanced processed data will include the appropriate coordinates, units, and time stamps. Each data file will be logically and sequentially named so that the file name can be easily correlated with project-specific naming conventions. The delivery requirements and schedule will be specified in Worksheet 29 of the QAPP and as requested by the client.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM.	All
1	12/05/19	Added clarification for dynamic data to support AGC cued survey (i.e., 25 cm merge radius)	3.2

SOP GEO 7: Field Notes for EM61

1. Purpose and Scope

This SOP describes note-taking procedures required when acquiring field data.

2. Personnel, Equipment, and Materials

2.1 Personnel

The following individuals will be involved in the creation of daily field notes for data collection of EM61 data:

- Site Geophysicist and/or Field Team Lead (FTL) /Member: Operates geophysical sensor during data collection. The Site Geophysicist or FTL will be responsible for sending daily data, field notes, and photos to the data processor.

2.2 Equipment and Materials

The following is a list of equipment and materials that may be required:

- Field notebook: lined, water-resistant notebook (not spiral-bound)
- Pens: non-erasable

3. Procedures and Guidelines

Daily records will be maintained by field geophysicists in a field notebook during data acquisition. Any errors in note taking should be struck through with a single line that does not obscure erroneous text. The note taker's initials should accompany any corrections. All pages must be numbered and dated to ensure that no pages are removed or lost. Field records will include:

1. Survey crew personnel. Sensor operator and note-taker must be identified.
2. Weather, temperature, humidity, moisture, and wind for the day, or as they change throughout the day.
3. Date and time of important survey events, including: background measurements, QC tests, changing survey area or batteries, and changes in survey crew.
4. Sketches of survey areas indicating obstacles, fence lines, power lines, and other relevant geographic or geophysical information.
5. Qualitative assessment of moisture and any potential sources of interferences (e.g., power lines, electrical fences, etc.). Examples of environmental conditions that may affect test results include the following:
    a. Rapid (over the course of an hour) changes in soil moisture levels. This could result from heavy rains or thunderstorms, or heavy dew that dries up during the first hour of surveying.
    b. Interference from overhead high-voltage lines. To assess this interference, two background measurements should be collected closely in time.

    c. Interference from intermittent radar sources or other high-power microwave sources (this would most likely occur at or near airports).

6. When multiple sensors are operated simultaneously, the minimum separation maintained between units (≥ 200 feet recommended).
7. The raw data file name associated with each file collected and the name of the instrument operator(s).

4. Backup of field notes

All field notes must be retained throughout a project. Notes should be digitized on a regular basis (a digital photo of each page is acceptable).

5. File naming conventions

All data files acquired in the field must have unique names. A unique data file will be started for each of the following events:

- Static/ Cable/ Personnel test
- Each time the IVS is performed
- When data acquisition is started in a new area
- When the system is powered-off and back on, including battery swaps[1]
- Each time an issue with the system that could have a significant impact on data quality is identified and corrected (loose wheel, loose cable, metal caught on system, etc.).

Files will be named on the field computer using the date in a MMDDYY format, followed by a sequential letter, and the team number. For January 31, 2018 Team 2, the first file name would be “013118a2,” and the second file would be “013118b2.” Teams should avoid generating large numbers of files outside of the events listed above, to reduce the effort in later data processing. Daily Checks should be labeled with an identifier indicating the type of check, followed by the date and an ‘a’ for AM or ‘p’ for PM, as applicable for twice daily checks. For example, the AM IVS check on January 31, 2018 should be labeled “IVS013118a2”. Tests repeated for any reason will have the AM/PM designator increased to the next letter in the alphabet. For example, the second AM IVS check on January 31, 2018 should be labeled “IVS013118b2”.

Prefixes:

CAB for cable shake

PER for personnel test

STA for static test

BCK for background strip

IVS for IVS strip

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[1] EM61 batteries will be swapped out before battery voltage drops below 11.0 volts

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP.	All

SOP GEO-8: Anomaly Stakeout

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when staking out targets for intrusive investigation. This SOP will ensure stakeout procedures conform to industry standards and will be consistently implemented. Stakeout may be performed in conjunction with intrusive operations.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

At least two of the following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist
- Site Geophysicist
- Field Team leader or Member

2.2 Equipment and Materials

The following is a list of required equipment and materials:

- Trimble R8, R10, Leica GS18 or similar RTK GPS
  Or
- Trimble S5, S7, Leica TS16 or similar RTS
- Target list (e.g., csv ASCII file)

3. Procedures and Guidelines

3.1 Positioning Equipment setup and assembly

The field geophysicist will assemble and test the positioning equipment according to the procedures described in SOP GEO-1a or SOP GEO-1b.

3.2 Anomaly Stakeout

The anomaly stakeout team will stakeout the geophysical anomalies identified for excavation on the dig sheets using RTK GPS or RTS. The anomaly stakeout will be conducted separately or in conjunction with intrusive operations using the following general sequence and procedures:

- Target lists will be generated with unique identification numbers, northing and easting positional data, and peak values.
- Selected targets will be submitted for internal review and approval.
- The target lists will be given to the stakeout teams, who will locate the targets using RTK GPS and mark the location with a vinyl pin flag. The lists will be formatted in Comma-Separated Values (.csv) file format with the above values, in order, and no headers.

- If stakeout is not performed in conjunction with intrusive operations, the unique target ID will be written on the flag using permanent marker.

Stake out of points will follow procedures described in SOP GEO-1a (RTK) or SOP GEO-1b (RTS).

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data deliverables.

4.1 Input data

Input data required for this SOP are the target list including position information.

4.2 Output data

The data outputs are the stakeout positions downloaded from the controller.

5. Quality Control

QC will be handled in-field by the rover operator. Refer to SOP GEO-1a for proper system setup. The operator will view the offset of the staked out point from the input target position as given on the controller. The rover operator will ensure the total offset does not exceed 10 centimeters.

6. Reporting

Depending on project requirements, the stakeout locations may be included in the project database. Refer to the QAPP.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP.	All

SOP GEO-9: Reacquisition

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when reacquiring targets for stakeout or intrusive investigation. Reacquisition is necessary to determine the peak location of a target identified from EM61 data. This SOP will ensure reacquisition procedures conform to industry standards and will be consistently implemented. Reacquisition may be performed in conjunction with stakeout (SOP GEO-8).

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

At least one of the following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist
- Site Geophysicist
- Field Team leader or Member

2.2 Equipment and Materials

The following is a list of required equipment and materials:

- EM61: The EM61 sensor system will be used to provide real-time anomaly response
- Trimble R8, R10, Leica GS18 or similar RTK GPS
  Or
- Trimble S5, S7, Leica TS16 or similar RTS
- Target list

3. Procedures and Guidelines

3.1 EM61 Setup and Assembly

The field geophysicist will assemble and test the EM61 according to the procedures described in SOP GEO-2.

3.2 Positioning Equipment setup and assembly

The field geophysicist will assemble and test the Positioning equipment according to the procedures described in SOP GEO-1a and SOP GEO-1b.

3.3 Anomaly Stakeout

The anomaly stakeout team may have staked out the geophysical anomalies identified for excavation on the dig sheets using RTK GPS or RTS according to SOP GEO-8.

3.4 Reacquire Anomaly

The EM61 operator will null the instrument over an area free of an anomalous signature. The operator will then navigate the EM61 cart over the location indicated by the rover operator or where the anomaly was flagged during stakeout. The operator will roll the cart back and forth in one cardinal direction as necessary to locate the position of the peak response. The operator will turn the EM61 cart perpendicular to the cardinal direction and repeat to find the peak in this direction. In this fashion, the operator will determine the peak location of the anomaly. The operator will then indicate the peak response location for intrusive investigation.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data deliverables.

4.1 Input data

Input data required for this SOP are the target list including position information.

4.2 Output data

The data outputs are the peak anomaly response and position. Project requirements may dictate recording of the peak response and reacquired location which will be stored in and downloaded from the GPS controller.

5. Quality Control

QC will be handled in-field by the EM61 operator. The operator will null the instrument as necessary and compare DGM target amplitudes with in-field observations.

6. Reporting

Depending on project requirements, the EM61 peak response and location may be included in the project database. Refer to the QAPP.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP.	All

SOP GEO-10: Anomaly Resolution

1. Purpose and Scope

The purpose of this standard operating procedure (SOP) is to identify the methods to be employed when performing anomaly resolution. Anomaly resolution is performed in conjunction with intrusive investigation to verify the source of the anomaly was fully recovered. This SOP will ensure anomaly resolution procedures conform to industry standards and will be consistently implemented.

2. Personnel, Equipment, and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 Personnel

At least one of the following personnel will be involved in the implementation of this SOP. Their qualifications are documented in QAPP Worksheet # 4, 7, and 8.

- Project Geophysicist
- Site Geophysicist
- Field Team Leader or Member
- UXOQC

2.2 Equipment and Materials

The following is a list of required equipment and materials:

- EM61: The EM61 sensor system will be used to provide real-time anomaly response
- Target list

3. Procedures and Guidelines

3.1 EM61 Setup and Assembly

The Field Team Lead or their alternate will assemble and test the EM61 according to the procedures described in SOP GEO-2.

3.2 Anomaly Resolution

The EM61 operator will null the instrument over an area free of an anomalous signature. When directed by the dig team that the anomaly source has been investigated, the operator will then navigate the EM61 cart over the location of the target. The operator will roll the cart back and forth in one cardinal direction as necessary to determine if an anomalous response still exists. If there is no response, the operator will turn the EM61 cart perpendicular to the cardinal direction and repeat to check for a response in this direction. The EM61 operator must also check the spoils pile for an anomalous response. The project specific allowable response above background will be given in the QAPP, however, in general, the response must be below the target selection threshold for a target to be resolved. If the EM61 operator sees a response above the allowable response, the operator will indicate where the peak response is to the dig team. The dig team will resume their intrusive investigation until they believe the target to be resolved. This process will repeat until the EM61 operator finds no response above the allowable response.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data deliverables.

4.1 Input data

Input data required for this SOP are the target list including position information.

4.2 Output data

The data outputs are the post-dig response at the target locations.

5. Quality Control

QC will be handled in-field by the EM61 operator. The operator will null the instrument as necessary and verify the EM61 is operating as intended.

6. Reporting

Any reporting for this SOP will fall under the intrusive investigation SOP.

REVIEW LOG

Revision Number	Change Date	Description of Change	Location of Change
0	06/06/19	Initial release for AECOM MMRP.	All

APPENDIX F.3

SAMPLING – STANDARD OPERATING PROCEDURES

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TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

FIELD PROCEDURES – EQUIPMENT DECONTAMINATION

Page 1 of 12
SOP Number: 02-03-06
Effective Date: 1/1/2020

Technical Approval:______________________________Date: 1/1/2020

QA Management Approval: David E. Dobb ____________ Date: 1/1/2020

SOP Description

This Standard Operating Procedure (SOP) establishes the procedures to be used by TechLaw Consultants staff when decontaminating and cleaning sampling equipment in the field. This SOP supports field work associated with government and commercial clients. Although these procedures are applicable to most situations encountered in the field, special situations may arise where deviations may be necessary. In either case, the specific decontamination and cleaning procedure must be outlined in the site-specific sampling and analysis plan (SAP) and/or quality assurance project plan (QAPP). Changes due to emergency or unforeseen situations arising in the field should be thoroughly documented in the field logbook and approved by the field team leader.

Definitions:

"Regions" refers to the U.S. EPA Regions (Regions 1 through 10).

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures

10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI SOPs

Equipment and Apparatus (may include, but is not limited to)

- Dish pans and/or wash tubs
- Scrub brushes
- Phosphate-free laboratory detergent (e.g., Liqui-Nox®)
- Solvent and/or acid rinse solutions (as required)
- Plastic sheeting
- Metal racks and/or sawhorses (as needed for large equipment)
- Drums or other receptacles (for wash/rinse wastewaters and used plastic sheeting)
- Squeeze bottles and/or pump sprayers
- Aluminum foil

General Requirements

Decontamination Procedure Selection

The specific decontamination procedure required for a project depends upon several factors.

- **Health and Safety** – This is the primary consideration in selecting the proper decontamination procedure. All employees will be provided with appropriate personal protective equipment, selected for the anticipated field activity and respective of the nature of the contamination at issue. No TechLaw Consultants employee will be asked to participate in any action which places them at risk.

- **The location of Agency or client for which the Project Is Being Conducted** - This is the second most important consideration in selecting the proper decontamination procedure. The decontamination procedure for any TechLaw Consultants project must be selected with this in mind. If no specific decontamination procedure is required by EPA or commercial client for the location in which the project is being conducted, then the TechLaw Consultants basic decontamination procedure described in this SOP will be sufficient. However, if a more stringent procedure is required, it must be included in the project site-specific SAP and/or QAPP.

- **The Level of Data Quality Required** - The level of data quality required for successful completion of the project is the third consideration in selecting the proper decontamination procedure. All sampling and field equipment must be cleaned in accordance with the procedure which meets the minimum requirements established for the Data Quality Objectives (DQOs) for the project. DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions based on the intended use of the data. DQOs provide information on the limits of the data, which in turn, dictate the proper uses of the data.

- **The Nature of the Project -** The fourth consideration in selecting the proper decontamination procedure is the nature of the project (e.g., full-scale investigation versus oversight activities). Full-scale investigations involving intensive sampling by TechLaw Consultants personnel will usually require the use of a stringent decontamination procedure. In a situation such as this, the sampling team is responsible for supplying and decontaminating the sampling equipment. However, in oversight situations where TechLaw Consultants personnel are only responsible for the collection of split samples, the required decontamination procedure may be minimal, and may be the same as the facility's contractor, or none at all. A decontamination procedure usually is limited for oversight projects since the facility's contractor is responsible for providing the sampling and decontamination equipment.

Equipment and Apparatus

A sufficient quantity of clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning. However, this is not always possible for some specialized items of field equipment (e.g., portable power augers, drilling rigs, and other large pieces of equipment). In addition, it may not be practical or possible to transport to the field all of the necessary pre-cleaned field equipment required for large-scale investigations. Consequently, the procedure for cleaning and decontaminating the sampling equipment must be determined prior to beginning work in the field. The methods for cleaning sampling equipment in the field must be described in detail in each project SAP and/or QAPP. The standard procedures (i.e., TechLaw Consultants, as well as EPA region-specific) for cleaning this equipment in the field are contained in this SOP.

The Use of Solvents

As a general rule, it is preferable to keep the decontamination procedure as simple as possible. The use of solvents (e.g., pesticide-grade acetone, methanol, isopropanol, and hexane) and acid rinses (e.g., hydrochloric and nitric acid) should be discouraged, if at all possible. Solvents and acid rinses should be avoided because they can be chemical hazards when used in the field and are at risk of being spilled. Furthermore, they are considered by the Department of Transportation (DOT) as hazardous material and must be shipped to, and from, the field as hazardous material/dangerous goods subject to DOT and UN ICAO/IATA regulations. See SOP Nos. 04-03-XX and 04-04-XX for further details regarding the packaging and shipping of hazardous materials/dangerous goods. Finally, the spent materials may be determined to be hazardous wastes, which require manifesting and off-site shipment to a treatment, storage, or disposal (TSD) facility. See SOP No. 02-04-XX for information on the management of investigation derived waste (IDW). Consequently, the use of solvents and acid rinses should be avoided unless specifically required by EPA, other regulatory agencies or a commercial client.

If solvents must be used in the field, only the smallest volume required to complete the field activities should be used to minimize the volume of solvents to be disposed. Solvents should be selected based upon the project analytical parameters of interest and risk. For example, acetone should not be selected as a decontamination solvent if it is one of the analytical constituents of concern. Methanol is more toxic than either isopropanol or acetone and should be avoided. Furthermore, hexane and petroleum ether are not miscible with water, which limits their use as rinsing agents. Although hexane is frequently used to remove contaminants from sampling equipment which are not easily removed by other solvents, it is preferable to avoid using hexane and replace the contaminated equipment with new equipment.

Sample Containers

Sample containers do not need to be cleaned in the field, as they will be purchased pre-cleaned and certified from the analytical support laboratory or an independent container supplier.

Use of Phosphate-Free Laboratory Detergent

The detergent used in the field should consist of a standard brand of phosphate-free laboratory detergent such as Liqui-Nox®. The use of other detergents such as a commercial phosphate-free dishwashing or laundry detergent is discouraged. Those detergents may only be used if they are clearly specified and approved in the SAP, and documented in the field logbooks and any reports produced.

Water Source

Tap water may be obtained from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute for tap water. Water shall not be used to decontaminate field equipment unless the source of the water is known.

Deionized (DI) water is defined as tap water that has been treated by passing through a standard deionizing resin column. The DI water should contain no heavy metals or other inorganic compounds (i.e., at or above analytical detection limits). Laboratory-grade DI water is suitable for these purposes. Distilled water may also be suitable as a water source in some cases. If distilled water is used, it must be documented in the field notebook or the electronic data collection device. If unexpected circumstances happen in the field and purchasing distilled water is required, the field samplers need to submit a sample of the purchased water for confirmation of purity.

Organic-free water is defined as tap water that has been treated with activated carbon and deionizing units. Distilled and/or Laboratory DI water does not qualify as an organic-free water substitute. However, commercial HPLC-grade water is usually acceptable provided the supplier has performed analysis on the water and can provide the certificates of analysis. Organic-free water should contain no pesticides, herbicides, extractable organic compounds, and less than 5 µg/L of purgeable organic compounds. During cleaning operations, the substitution of a higher-grade water (i.e., DI or organic-free water for tap water) is permitted and need not be noted in the field logbook as a variation of this SOP. The substitution of a lower-grade water is not permitted.

Post-Sampling Requirements

Prior to departing the field at the conclusion of the sampling activities, all sampling equipment should be cleaned on site after final use, unless prohibited by special circumstances. There may be situations like bad weather where decontamination in the field is not feasible in which case decontamination would have to be performed back at the field warehouse or laboratory and generated IDW would need to be handled there. The date of decontamination must be clearly marked on the equipment (usually on wrapping materials or tags attached to the equipment), along with information stating whether solvent and/or acid rinses were used.

All spent solvents, acid rinse solutions, detergent wash waters, and rinse waters used to clean equipment shall not be reused, unless specifically permitted in the SAP. Arrangements should be made in advance of initiating activities for disposal of all cleaning wastes. If an operating wastewater treatment plant is present at the facility, decontamination solutions may be disposed of in the plant influent with permission of the facility. Permission may also be requested to dispose of solvents and acid rinse solutions into the facility's laboratory waste containers. Regardless of the method of disposal, permission should be obtained from the facility prior to arriving on site.

If a disposal system is not available locally or if permission to use on-site facilities cannot be obtained, containerize the solutions for later shipment and obtain a sample of each container for laboratory analysis. The containers must be secured so they may be stored until the analytical results are available. Arrangements for disposal should be made prior to departing the facility, if at all possible. Refer to SOP No. 02-04-XX for further information regarding the management and disposal of investigation-derived wastes.

Sampling Equipment Cleaning Procedures

The recommended TechLaw Consultants basic decontamination procedure is listed below. At a minimum, this procedure should be followed for all investigatory activities at hazardous waste sites. More stringent decontamination procedures may be required (e.g., criminal enforcement investigations, EPA regional requirements, etc.). For regions where specific decontamination procedures exist, they are listed below. The TechLaw Consultants basic decontamination procedure should be used under all circumstances, except where a more stringent procedure is required by EPA, state, or other regulatory agencies. If more stringent procedures are required, these procedures must be documented in the SAP or QAPP.

- Upon arriving at the site, establish an equipment decontamination area. Refer to Attachment A for a typical decontamination area layout. This area should be upwind and away from sources that might contaminate the cleaned equipment. If a decontamination pad has been constructed for the investigation, conduct the decontamination activities over the pad.

- Cover the working surface with large plastic (polyethylene) sheets. Establish separate areas for contaminated equipment storage, contaminated equipment wash, equipment rinse (including solvent rinses if required), equipment drying, clean equipment storage, cleaning supplies storage, and contaminated wash and solvent solution storage.

- Place dish pans and/or wash tubs on the plastic sheets in the required wash and rinse sequence. Fill the first wash tub with a phosphate-free detergent (e.g., Liqui-Nox®) and tap water solution for washing contaminated equipment. The remaining dish pans and/or wash tubs should remain empty; these pans are used for collecting rinse solutions.

- Fill the squeeze bottles and/or pump sprayers with the tap water and distilled/DI water rinse solutions. If solvents, acid rinses, and organic-free water rinses are required by the regulatory agencies, fill the squeeze/sprayer bottles with these solutions.[1] Place each rinse solution (e.g., tap water, deionized water, solvent, acid rinse) in a separate container; never mix uncontaminated rinse solutions in the same container. Hold the squeeze bottles or pump sprayers over the dish pans/wash tubs while pouring the solutions to collect any spillage which may occur during the process.

- Put on clean gloves and begin decontaminating the equipment. It may be advisable to put on multiple layers of gloves for the different stages of decontamination and strip off a layer after each stage.

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[1] Several EPA regions require that solvents, acid rinses, deionized water, and organic-free water be dispensed from non-interfering glass, Teflon®, or stainless steel containers; plastic containers are usually not approved for these solutions. If these solutions must be used in the decontamination sequence, refer to the specific requirements for the EPA region in which the work is being conducted.

- Wash the contaminated equipment in the first wash tub filled with a phosphate-free detergent (e.g., Liqui-Nox®) and tap water solution, using scrub brushes, if necessary, to remove particulate matter and surface films. The detergent solution should be replaced when it becomes visibly contaminated and fails to effectively clean the equipment.

- Rinse the equipment thoroughly over the second wash tub with tap water. The water may be dispensed from the squeeze bottles or pump sprayers.

- Rinse the equipment thoroughly over the third wash tub with deionized water. If preferred, the deionized water rinse can also be conducted over the second wash tub, since water is used as the rinsing agent in both cases.

- Place the decontaminated equipment on clean plastic sheeting and allow it to completely air dry.

- Wrap the equipment with aluminum foil or clean plastic, if appropriate, to prevent contamination of the equipment if it is going to be stored or transported.

- Clean small equipment (e.g., sampling dishes/pans, stainless steel spoons, split-spoon samplers, and Shelby tubes) by submerging the equipment directly into the detergent-filled wash tub. Clean large equipment (e.g., power augers, drill rods, drill bits, and auger flights) by supporting the equipment on metal racks and/or sawhorses over the decontamination pad or plastic sheeting.

- Dispose of all spent decontamination solutions into the facility wastewater treatment system influent, or containerize the solutions into drums or other receptacles for later disposal. If the solutions are containerized, collect a sample of each solution for waste characterization. Secure the containers so they may be stored until the analytical results are available. If possible, finalize disposal arrangements prior to leaving the site. Refer to SOP No. 02-04-XX for further information regarding the management and disposal of investigation-derived wastes.

- Dispose of the used plastic sheeting by placing it into a drum or other receptacle for later disposal.

- Store all cleaned field and sample equipment in a contaminant-free environment.

While using acids and/or solvents is avoided if possible, they are needed at times to properly decontaminate equipment (e.g., oily wastes are being sampled). In such cases, the following procedure should be followed:

For organics:

- Phosphate-free laboratory detergent wash;
- Tap water rinse;
- Pesticide-grade hexane or methanol* rinse;
- Reagent-grade acetone* rinse;
- Organic-free reagent water rinse; and
- Air dry.

*Isopropanol may be substituted as the solvent if hexane, methanol, or acetone is a constituent of interest.

For inorganics:

- Phosphate-free laboratory detergent wash;
- Tap water rinse;
- Dilute hydrochloric or nitric acid rinse;
- Reagent water rinse; and
- Air dry.

Source: U.S. Environmental Protection Agency, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001, November 1992.

EPA Regional Decontamination Variations

The cleaning and decontamination procedure selected for use in the field should contain as few steps as possible to acquire agency approval. The use of solvents in the field should be discouraged at all times, if possible. In all cases, the above-listed basic decontamination procedure should be used. However, certain EPA regions may require that a more stringent and specific decontamination procedure be followed for investigations conducted in their specific regions.

This section of the SOP contains the known decontamination procedures required or accepted by the various EPA Regions. In regions where a published and approved decontamination procedure exists, the region-specific SOP is listed. In all cases, the TechLaw Consultants field team should discuss the decontamination procedure with the client to determine if there are any state, regional or client-specific procedures that will be required and those procedures should be documented in the SAP and QAPP.

EPA Region IV:

Standard Operating Procedure for Trace Organic and Inorganic Sampling Equipment:

For samples undergoing trace organic or inorganic constituent analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

- Clean with tap water and Luminox® soap using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (Luminox® soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
- Rinse thoroughly with tap water.
- Rinse thoroughly with organic-free water and place on a clean foil-wrapped surface to air-dry.
- All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

Source: U.S. Environmental Protection Agency, Field Branches Quality Management Plan System and Technical Procedures; Field Sampling Procedures, Field Equipment Cleaning and Decontamination, U.S. EPA Region IV, December 2011 (note: Region IV-required cleaning procedures for specific equipment such as certain groundwater pumps and drilling equipment are also contained in this document)

Health and Safety

Some of the materials used to implement the cleaning procedures outlined in this SOP can be dangerous if improperly handled. Due caution must be exercised by all personnel and all applicable safety procedures shall be followed. At a minimum, the following precautions shall be taken during cleaning operations:

- Safety glasses with splash shields or goggles and chemical resistant gloves are to be worn during all cleaning operations;

- All solvent rinsing operations are to be conducted under a fume hood or in the open (never in a closed room); and

- No eating, smoking, drinking, chewing, or any hand-to-mouth contact is permitted during cleaning operations.

It is TechLaw Consultants' policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with the Occupational Safety and Health Administration (OSHA) requirements and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the HSD prior to implementation in the field. This plan must be reviewed with the TechLaw Consultants field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

The effectiveness of the equipment cleaning procedure used shall be monitored by rinsing cleaned equipment (equipment used to collect samples) with organic-free or DI water and submitting the rinse water for all of the constituents of concern required by the SAP and QAPP. At least one such sample shall be collected from each piece of equipment used. Depending upon the procedures in the SAP, more samples may be collected. All such samples may not be analyzed, but should be available in the event contamination is suspected. Normally, the QC samples analyzed will not exceed 5 or 10 percent of the total samples collected.

Samples of all rinse materials shall be collected in the field. In any instance where a new source of cleaning materials or rinse water is substituted as a component of the selected decontamination procedure, a sample of that cleaning material or rinse water shall also be collected.

Comments/Notes

None at this time.

Attachments

Attachment A – Decontamination Area Layout

References

TechLaw Consultants, Corporate Quality Management Plan, most current revision.

TechLaw Consultants, Health and Safety Program, most current version.

New York State Department of Environmental Conservation, Division of Hazardous Substances Regulation, RCRA Quality Assurance Project Plan Guidance, Appendix E, 1991.

U.S. Environmental Protection Agency, Region II CERCLA Quality Assurance Manual, U.S. EPA Region II Environmental Services Division, Revision No. 1, October 1989.

U.S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, Washington, D.C., 1987.

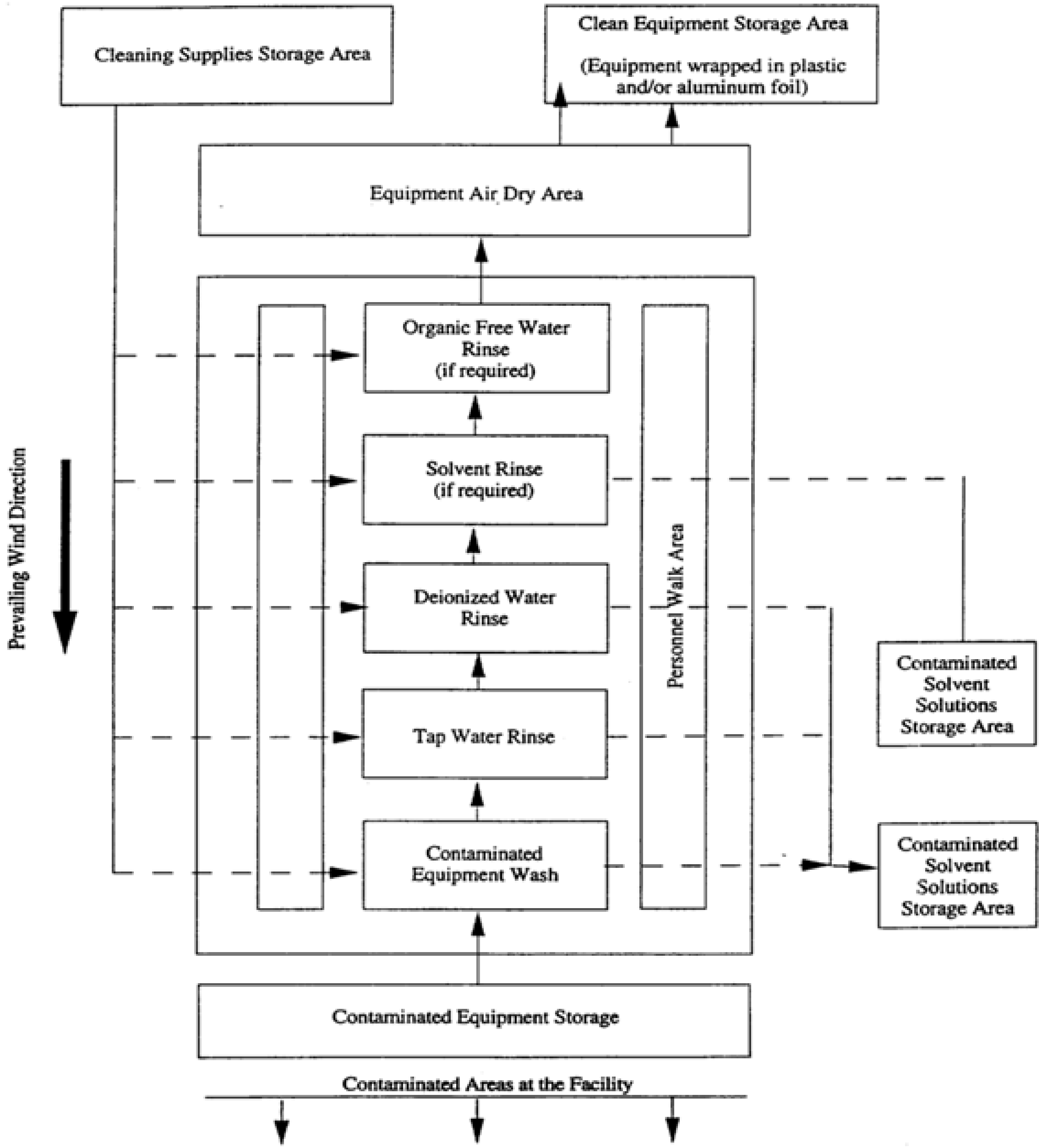
U.S. Environmental Protection Agency, Field Branches Quality Management Plan System and Technical Procedures; Field Sampling Procedures, Field Equipment Cleaning and Decontamination, U.S. EPA Region IV, December 2011.

U.S. Environmental Protection Agency, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001, November 1992.

U.S. Environmental Protection Agency, RCRA Sampling Procedures Handbook, U.S. EPA Region VI, May 1998.

ATTACHMENT A [Revised 1/1/2020]
SOP Number: 02-03-06

DECONTAMINATION AREA LAYOUT



RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
02-03-05	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
02-03-06	12/20/2017	Reviewed for changes, minor changes made throughout
02-03-06	1/1/2020	Changed Company Name to TechLaw Consultants, Inc.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

FIELD PROCEDURES – MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

Page 1 of 13
SOP Number: 02-04-08
Effective Date: 08/06/2021

Technical Approval: ______________________ Date: 08/06/2021

QA Management Approval: ______________________ Date: 08/06/2021

SOP Description

This Standard Operating Procedure (SOP) describes the internal and regulatory guidelines required for the management of materials, wastes, and/or media generated during site investigations. This SOP is to be followed by TechLaw Consultants project managers or designee to develop a plan to manage the investigation-derived waste (IDW) potentially generated during site investigations, sampling visits, Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) oversights, and other investigative activities for private clients and regulatory agencies. This SOP describes various activities that generate IDW, the types of IDW commonly generated, and the regulatory guidelines available to develop an adequate IDW management plan.

The IDW management plan should be site-specific and be either a stand-alone document or incorporated as part of the site-specific project work plan. Each client or regulatory agency may have specific requirements for the proper management of IDW. The IDW management plan should be discussed with clients and regulatory agencies, as applicable, prior to initiating field activities that may generate IDW.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures

08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI – Specific SOPs

Related Documentation and Apparatus

The following documentation can be used in developing an IDW management plan:

- Project-specific quality assurance project plan (QAPP);
- Relevant site information such as previous sampling data, waste characterization data, and regulatory agency files; and
- Regulatory specific documents or guidelines related to the management of IDW (i.e., *Guide to Management of Investigation-Derived Wastes, Publication: 9345.3-03FS, April 1992*).

Investigation Derived Waste: Activities and Types

IDW are wastes generated during the conduct of field sampling investigation or remediation activities at RCRA, CERCLA, or other sites that potentially contain hazardous wastes or substances. IDW can be hazardous or non-hazardous wastes.

When conducting field operations, such as RCRA or CERCLA investigations and other sampling activities, intrusive field investigative operations (e.g., soil sampling or well installation) may be conducted. These activities could generate IDW, which can be in the form of liquid and/or solids. Other non-hazardous wastes, such as trash and/or scrap materials, may also be generated during field operations. Some of the more common field activities and the types of IDW generated are:

Activity	Type of Wastes
Well Installation	Soil cuttings, purge water, grout, muds, personal protective equipment (PPE), drilling fluids, decontamination fluids
Groundwater sampling	Purge water, decontamination fluids, PPE
Soil Sampling	Decontamination fluids, PPE, solids
Waste Sampling	PPE, decontamination fluids, waste residuals, disposable sampling equipment
Sludge/Sediment Sampling	PPE, solids, decontamination fluids
HazCating	PPE, test strips, chemicals, fluids tested
General Site Work	General trash (paper, tape, paper towels, wrappers, backer paper for labels, water bottles, etc.) and scrap materials (wood, metal, glass, etc.)

To handle IDW properly, the project manager must determine the types, characteristics and quantity of anticipated and resulting IDW.

Tasks Associated with IDW Management

The following discussion outlines the factors that should be taken into consideration when planning for proper management of IDW, including wastes, trash, and/or scrap materials. These factors need to be taken into consideration before fieldwork begins.

1. <u>Review relevant facility information</u>. Obtain from the client all relevant analytical data that will provide information on the potential characteristics of the waste generated during the field operations. Review previous analytical data, waste management plans, history of spills, permits, inspection results, and product and waste characteristics.

2. <u>Identify field activities generating IDW</u>. Review the proposed site-specific field investigation operations. *Will IDW be generated by any of the proposed investigation activities?*

   For example: If well installation is a planned field operation, various types of IDW will be generated. These could include, but not be limited to liquids (purge water, drilling fluids, decontamination fluids) or solids (soil cuttings, PPE).

3. <u>Identify quantity and type of IDW</u>. Based on the proposed IDW generating activities, determine the type of wastes, and quantity of each waste type, that need to be managed. Dependent upon this information, along with any site-specific

requirements, the type of containers (e.g., poly drums for liquid wastes, steel drums for solid wastes), as well the size and number of containers needed will then be determined. A single field operation can generate multiple types of IDW (e.g., well installation activity could generate: 30 gallons of purge water, 15 gallons of decontamination fluids, 1 drum of PPE, and 2 drums of soil cuttings).

4. Identify the potential waste characteristics. Use the relevant facility file information available about the site. *Will wastes generated be hazardous or non-hazardous?*

   To properly manage IDW, the project manager must know whether the IDW contains CERCLA hazardous substances, RCRA hazardous wastes or hazardous constituents, contaminants regulated under other statutes, or is non-hazardous. This information can be obtained from previous analytical data, waste management plans, history of spills, and product and waste characteristics. U.S. Environmental Protection Agency (EPA) guidance encourages, when applicable, the use of "generator knowledge" to determine waste characteristics. The level of such knowledge required to make a determination must take into account considerations of practicability and should reflect the scope of the field activities. Additionally, the sampling plan or objectives of the investigation may provide useful information for determining the potential waste constituents. (See Attachment A and B for more specific information regarding waste characterization). Limited field screening may also be used to assist in determining the waste characteristics (e.g., pH readings, or HazCating^{TM}).

5. Identify specific facility, state or Federal IDW management requirements. Discuss the generation of IDW with the facility and any state or federal agencies involved in the project. Determine any agency-specific requirements and include this information in the IDW management plan. The EPA document, *Management of Investigation-Derived Wastes During Site Inspections*, OERR Directive 9345.3-02, May 1991, can be useful in determining the appropriate management of IDW. See the discussion below, *Selecting IDW Management Methods.*

6. Subcontractors. Discuss the responsibility of IDW management with any and all subcontractors that will be part of the field operation team. Ensure that subcontractors are familiar with IDW management procedures, are prepared to properly manage IDW, and are qualified to support the field operations.

Selecting IDW Management Methods

Upon designating IDW either RCRA hazardous or RCRA non-hazardous, the project manager should determine the appropriate handling method. Attachment A to this SOP provides an IDW Management Decision Tree that provides an overview for selecting the best approach for IDW management, and the steps involved in executing the approach. This Decision Tree is taken from the EPA document, *Management of Investigation-Derived Wastes During Site Inspections, OERR Directive 9345.3-02, May 1991.*

Using the planning steps described in the above-referenced decision tree and the relevant EPA or other IDW management documents, the project manager should determine the most appropriate IDW management for the site-specific field operations. **It is critical that all aspects of IDW management be considered in the pre-planning stages of all investigations, prior to any field activities that may generate IDW**.

IDW Management Options

There are two basic management options for IDW, including trash and scrap materials: on-site and off-site. The following provides a brief discussion of the two options. Always consult the most current regulatory guidance and requirements to determine the most appropriate management methods. The facility, EPA, and/or State agency should be consulted as needed to comply with appropriate IDW management options. Where possible, non-hazardous waste materials, trash, and/or scrap materials should be segregated for the purpose of reuse or recycling.

On-site IDW Management can include, but is not limited to the following:

(These are examples. Site-specific methods will be determined based on site-specific information.)

Non-hazardous IDW

- Leave IDW with the facility for proper handling and management. This method has been a common method of IDW management. All waste materials will be properly stored and handled in accordance with applicable regulations and site-specific requirements. If wastes are stored outdoors, receptacles must be covered to prevent dispersion of waste materials, and to control the potential for run-off. Most facilities will accept the non-hazardous IDW. Permission must be obtained from the facility prior to leaving any IDW at a facility.

- Spread soils around boring and cover with surface soil, discharge liquids onto the ground area or next to the well, return sludge to the sludge pit. As with leaving the wastes onsite, permission must be obtained from the facility prior to placement on the land.

Hazardous IDW

- Hazardous IDW may be left with the facility representative for proper handling and management. All waste materials will be properly stored and handled in accordance with applicable regulations and site-specific requirements. All waste containers must be closed (i.e., drums) or covered (i.e. rolloffs,) to prevent a spill or release of waste materials to the environment. Spoils piles must be covered to prevent potential dispersion from wind or runoff. Spill/release controls (i.e., spill containment pallets for drums, absorbent waddles around storm drains near spoils piles, etc.) must be implemented for all waste storage areas. Prior arrangements must be made with the facility before the field activities begin. If working for a governmental agency, approval of this type of IDW management must be obtained from the regulatory agency as well.

- Contain IDW and leave on-site for future disposal. Many times, it may be necessary to contain IDW for a short-term storage period at the facility. All waste materials will be properly stored and handled in accordance with applicable regulations and site-specific requirements. All waste containers must be closed (i.e., drums) or covered (i.e. rolloffs,) to prevent a spill or release of waste materials to the environment. Spoils piles must be covered to prevent potential dispersion from wind or runoff. Spill/release controls (i.e., spill containment pallets for drums, absorbent waddles around storm drains near spoils piles, etc.) must be implemented for all waste storage areas. Analytical testing may be required to further characterize the IDW. All parties involved should be consulted (i.e., facility, governmental agencies), prior to leaving IDW at the facility. Special considerations may apply if this method is used, including, but not limited to, fencing to secure drums of IDW.

- IDW can be left on-site in an area designated as an Area of Contamination (AOC). All waste materials will be properly stored and handled in accordance with applicable regulations and site-specific requirements. All waste containers must be closed (i.e., drums) or covered (i.e., roll-offs) to prevent a spill or release of waste materials to the environment. Spoils piles must be covered to prevent potential dispersion from wind or runoff. Spill/release controls (i.e., spill containment pallets for drums, absorbent waddles around storm drains near spoils piles, etc.) must be implemented for all waste storage areas. The AOC concept applies only to contaminated soil (and sediments) from the inspected site. The AOC concept does not apply to wastes that did not originate from the AOC, such as PPE, decontamination fluids and groundwater. EPA requirements are specific for designating these areas. All relevant EPA and State regulations must be consulted before designating any area as an AOC. For sites with areas designated as Solid Waste Management Units or Investigation Areas (RCRA), or Areas of Concern (CERCLA), IDW must be left within the boundaries of these designated sites, and may include all wastes (soil, water, sludge, PPE, and decontamination fluids). Therefore, IDW management will be in accordance to the specific facility requirements.

Off-site IDW Management can include, but may not be limited to:

Non-Hazardous IDW

- Arrangements can be made for the delivery of non-hazardous IDW to the nearest industrial or municipal landfill or local Publicly Owned Treatment Works (POTW). Prior arrangements should be made with the off-site disposal facility before field activities begin. Off-site facilities may require some form of waste characterization or bill of lading.

Hazardous IDW

- Immediate containment and removal. Depending on the investigation circumstances, it may be necessary to contain and remove IDW during or immediately upon completion of the field activities. Extensive pre-planning is necessary. Consult with facility and governmental agencies to discuss the IDW management plan. Arrangements with transporters and disposal facilities must be coordinated in advance of any field activities. Allow for at least two full weeks of coordination.

Other methods may be appropriate. Pre-planning is essential to IDW management. The use of this SOP, the attachments and other resources on IDW management, should be consulted prior to initiation or implementation of any IDW management plan.

Implementation of IDW Management

The IDW management plan should be flexible to allow slight modifications due to unexpected and unforeseen field conditions. There are several items that should always be included in the implementation of an IDW management plan. These include, at a minimum, the proper handling and labeling of containers, and documentation of IDW management activities. Through the IDW management plan, employees are provided instruction on the proper handling, storage and disposal of non-hazardous and hazardous wastes. Also, consult Attachment B for other considerations.

<u>Container Selection.</u> If containerization of IDW is necessary, consider the type, quantity and characteristics of the IDW when selecting the proper container. When selecting the container, consider the compatibility of the container with the waste, size of container, and overall appropriateness of the container for the field activities (i.e., if waste is corrosive, steel containers would not be appropriate because of the incompatibility of the waste with the container). The potential disposal method will also influence container selection, as many disposal facilities have limitations on the volume(s) and container types they will accept.

<u>Handling and Labeling of Containers</u>. Hazardous IDW in containers, must be marked and labeled according to all applicable RCRA generator requirements of 40 CFR 262.30-262.34. All marking and labels must be applied before leaving the site. Marking and labeling must be made with indelible ink or self-adhesive labels.

<u>Documentation of IDW Management</u>. Document all IDW management activities in a field logbook and with photo documentation. See SOPs 03-01-XX and 03-02-XX (*Field Documentation Procedures-Maintenance of a Field Logbook* and *Field Documentation Procedures-Taking and Documenting Photographs*).

<u>Manifests/Bill of Lading</u>. If hazardous IDW needs to be disposed off-site, a Uniform Hazardous Waste Manifest must be completed. **TechLaw Consultants staff must <u>never</u> sign a hazardous waste manifest unless appropriate language has been added to the prime contract. This language must acknowledge that TechLaw Consultants is signing the manifest "on behalf of the client" and is not considered a generator solely as a result of signing the manifest**. Coordinate the manifest requirements with the client and receiver/transporter used to remove the IDW. The client will be notified that they are designated as the generator on all shipping papers and are required to sign all shipping papers unless other contractual arrangements have been made. Off-site disposal companies require some form of waste profile before waste pick-up. If the generator's knowledge is not acceptable for the waste profile, analysis of IDW for disposal should be included with the other project scheduled sampling and analysis. These issues should be considered in all pre-field planning activities.

If non-hazardous IDW will be disposed off-site, a bill of lading may be required by the facility selected to accept the wastes. Coordination with these facilities of waste acceptance requirements should be done before activities are initiated.

Copies of manifests or bill of lading must be maintained for TechLaw Consultants' project file. The generator copy should be provided to the client or signatory authority on the manifest.

Disposal Facilities. During the pre-planning phase, disposal arrangements made with the off-site facility should be obtained in writing. Before signing any contracts, coordinate with the Contracts Administrator and Legal Counsel for review and approval of any contract agreements.

Waste Definitions

In order for any material to be a hazardous waste, it must first be a *solid waste*. RCRA uses the term *solid waste* as any discarded material that is no longer used for its intended purposes, such as abandoned, recycled, inherently waste-like, and military munitions materials. It is important to note that the definition of solid waste is not limited to wastes that are physically solid. Many solid wastes are liquid, semi-solid, or contained gaseous material. Materials that do not meet the definition are not solid wastes and are not subject to RCRA regulation. Details of exclusions are found under 40 CFR §261.4.

Hazardous wastes are solid wastes that pose a substantial present or potential hazard to human health or the environment. More details for hazardous waste classification are provided below. *Environmental media* is soil, fill material, or other geologic materials at all depths, groundwater at all depths, surface water including storm water, indoor and outdoor air, and all living organisms, including all animals and plants.

Waste Characterization

Overview of the Waste Characterization Process

1. Sample waste (or use associated data).

2. Store waste in Department of Transportation (DOT)/United Nations (UN) rated and approved containers.

3. Use generator knowledge and/or analytical data to determine proper classification (hazardous, non-hazardous), and identify appropriate Treatment, Storage, and Disposal Facility (TSDF).

4. Submit profile with supporting analytical data to the TSDF.

5. Ensure approval by both the TSDF and the appropriate facility representative of the waste profile.

6. Schedule off-site transportation and disposal.

Waste Characterization – Hazardous vs. Non-hazardous

Under both Federal and State regulations, any entity that generates a solid waste must determine whether that waste is hazardous or non-hazardous using a systematic method. The following steps will be used to characterize waste streams:

1. Use process knowledge to determine potential contaminants in the waste that may result in classification of the waste as hazardous.

    a. Review historic operations and sample results from locations within the site, and/or historic samples from previously generated IDW.

    b. In the absence of data for a particular environmental medium from which waste is generated, determine if waste constituents may have migrated to that medium from known sources of contamination.

2. Review current investigative, confirmation, and IDW sampling analytical results to determine chemicals of concern and their concentrations. Sample and analyze the waste being generated to reduce waste characterization uncertainty.

    a. Typically, the available investigative, confirmation, or IDW sample analytical results are used in conjunction with supplemental analytical data that is specified by the receiving waste disposal facility. The wastes will be sampled and analyzed consistent with the methods identified in 40 CFR Part 261 or SW-846. Table 1 lists various test parameters that will be used, as appropriate, to characterize an unknown waste. Sample analysis will be completed by a certified laboratory as required by the EPA and applicable State agency.

TABLE 1
40 CFR 261 ANALYTICAL METHODS

Parameter	EPA Method
Ignitability	SW-846, Method 1010
Corrosivity	SW-846, Method 1030
Reactivity	SW-846, Chapter 7, Section 7.3
Paint Filter Test	SW-846, Method 9095
Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs)	SW-846, Methods 1311, 8260
TCLP Semi-volatile Organic Compounds (SVOCs)	SW-846, Methods 1311, 8270
TCLP Resource Conservation Recovery Act Metals	SW-846, Methods 1311, 6000 and 7000 Series
TCLP Pesticides/Herbicides	SW-846, Methods 1311, 8081/8151

3. Based on the information gathered in steps 1 and 2, along with the criteria provided below under Listed Hazardous Waste, Characteristic Hazardous Waste, Non-Hazardous Waste, and Contained-Out Criteria, a waste classification will be applied.

Listed Hazardous Waste

All listed hazardous wastes are included in Title 40 CFR part 261 subpart D and applicable state regulations. If analytical results and/or historical information indicate the potential presence of a listed hazardous waste in the environmental medium that becomes a generated waste, the generated waste will be classified as a listed hazardous waste unless other applicable State criteria are met.

Laboratory analysis will be used to determine if these codes apply. Listed wastes can be “contained out” (see below) if the waste is an environmental media that meets the requirements of State-specific criteria. Contained-out wastes are non-hazardous.

Characteristic Hazardous Waste

A characteristic hazardous waste differs from a listed hazardous waste in that it is a solid or liquid material that exhibits one or more of the following characteristics:

- Ignitability

- Corrosivity
- Reactivity
- Toxicity

Investigation-derived environmental media or investigation-derived solid waste will only be a characteristic hazardous waste if it contains enough hazardous constituents that the IDW itself exhibits one of the above characteristics. The criteria for determining if the waste meets one of the four characteristics are provided in 40 CFR Part 261 Subparts B, C, and D. Field screening, laboratory analysis, and generator knowledge will be used to classify wastes as characteristically hazardous.

Non-Hazardous Waste

IDW cannot contain any listed hazardous waste (or it has been "contained out" – see below) and cannot exhibit a hazardous waste characteristic to be considered a non-hazardous waste.

Contained-Out Criteria

Some states have developed criteria upon which contained-out determinations for environmental media contaminated with hazardous waste can be made. For contained-out determination of environmental media, the contaminated media must not exhibit a characteristic of hazardous waste. The concentrations of hazardous constituents from listed hazardous wastes must also be below health-based and groundwater protection levels. Refer to applicable state-specific guidance document for more details.

Health and Safety

It is TechLaw Consultants' policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with the EPA, DOE, and OSHA established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed shoes, safety glasses or splash shield and chemical resistant gloves. Specific protective equipment required for handling IDW must be addressed in the site-specific Health and Safety Plan.

QA/QC

None at this time.

Comments/Notes

The time required to prepare IDW Management plans should be built into the appropriate project budget.

Attachments

Attachment A – IDW Management Decision Tree; EPA OERR Directive 9345.3-02, May 1991.

Attachment B – Guide to Management of Investigation-Derived Wastes, EPA Publication 9345.3-03FS, April 1992.

References

Code of Federal Regulations (CFR) 40, Parts 260-280, Protection of Environment.

Code of Federal Regulations (CFR) 40, Part 300, National Oil and Hazardous Substances Pollution Contingency Plan.

TechLaw Consultants, Corporate Quality Management Plan, current version.

TechLaw Consultants, Health and Safety Program Plan, current version.

U.S. EPA, Office of Emergency and Remedial Response Hazardous Site Control Division, Guide to Management of Investigation-Derived Waste, Publication 9345.3-03FS, April 1992.

U.S. EPA, Management of Investigation-Derived Wastes During Site Inspections, OERR Directive 9345.3-02, May 1991

U.S. EPA, Management of Remediation Waste Under RCRA, (EPA 530-F-98-026), October 1998. http://www.epa.gov/compliance/resources/policies/civil/rcra/remediawaste-rpt.pdf

Superfund Remedy Decisions/Waste Management, EPA Website http://www.epa.gov/superfund/policy/remedy/sfremedy/waste.htm

ATTACHMENT A [Revised 08/06/2021]
SOP Number: 02-04-08

IDW MANAGEMENT DECISION TREE

EPA/540/G-91/009
OERR Directive 9345.3-02
May 1991

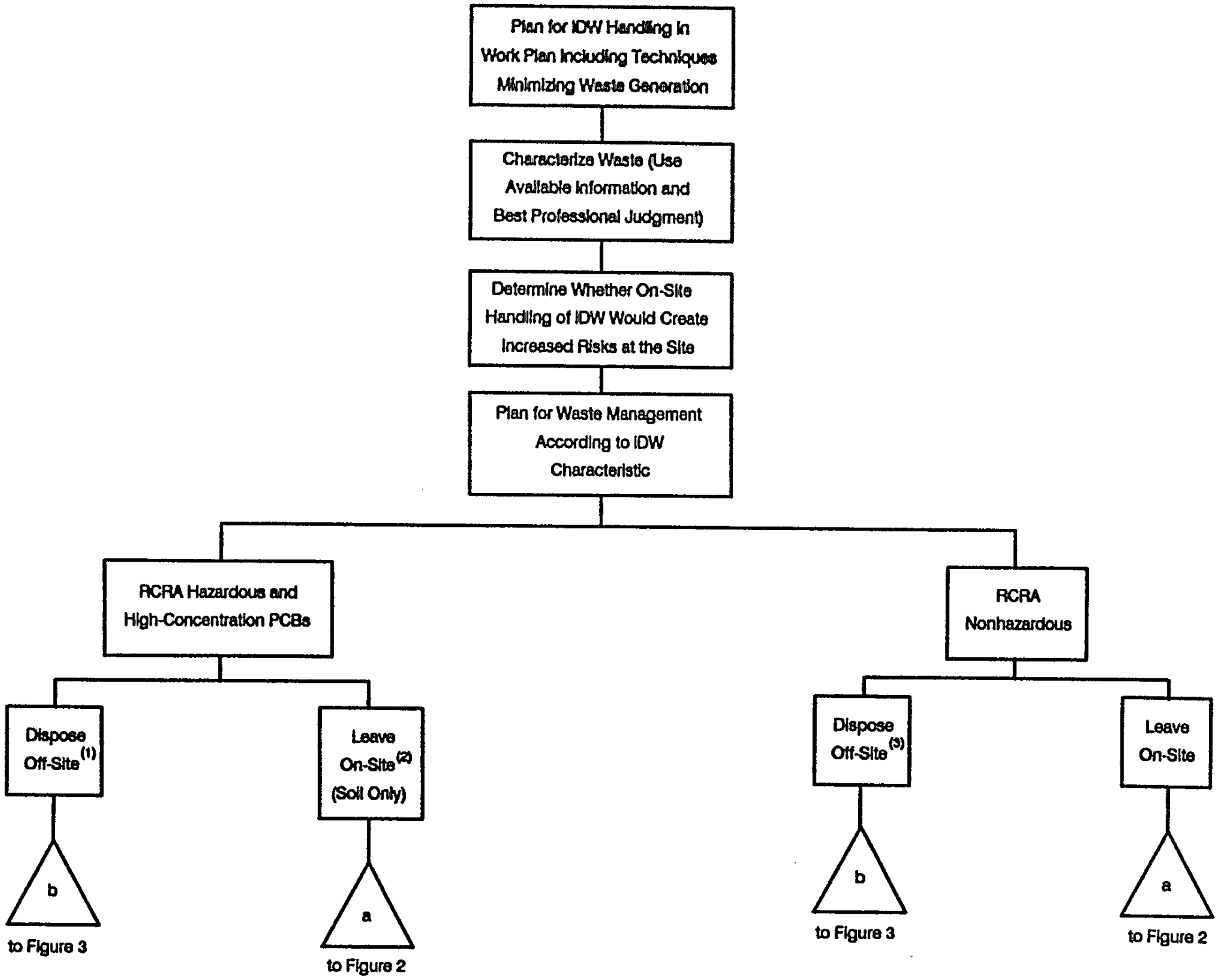
Management of Investigation-Derived Wastes During Site Inspections

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

Printed on Recycled Paper

Figure 1

IDW Management Decision Tree



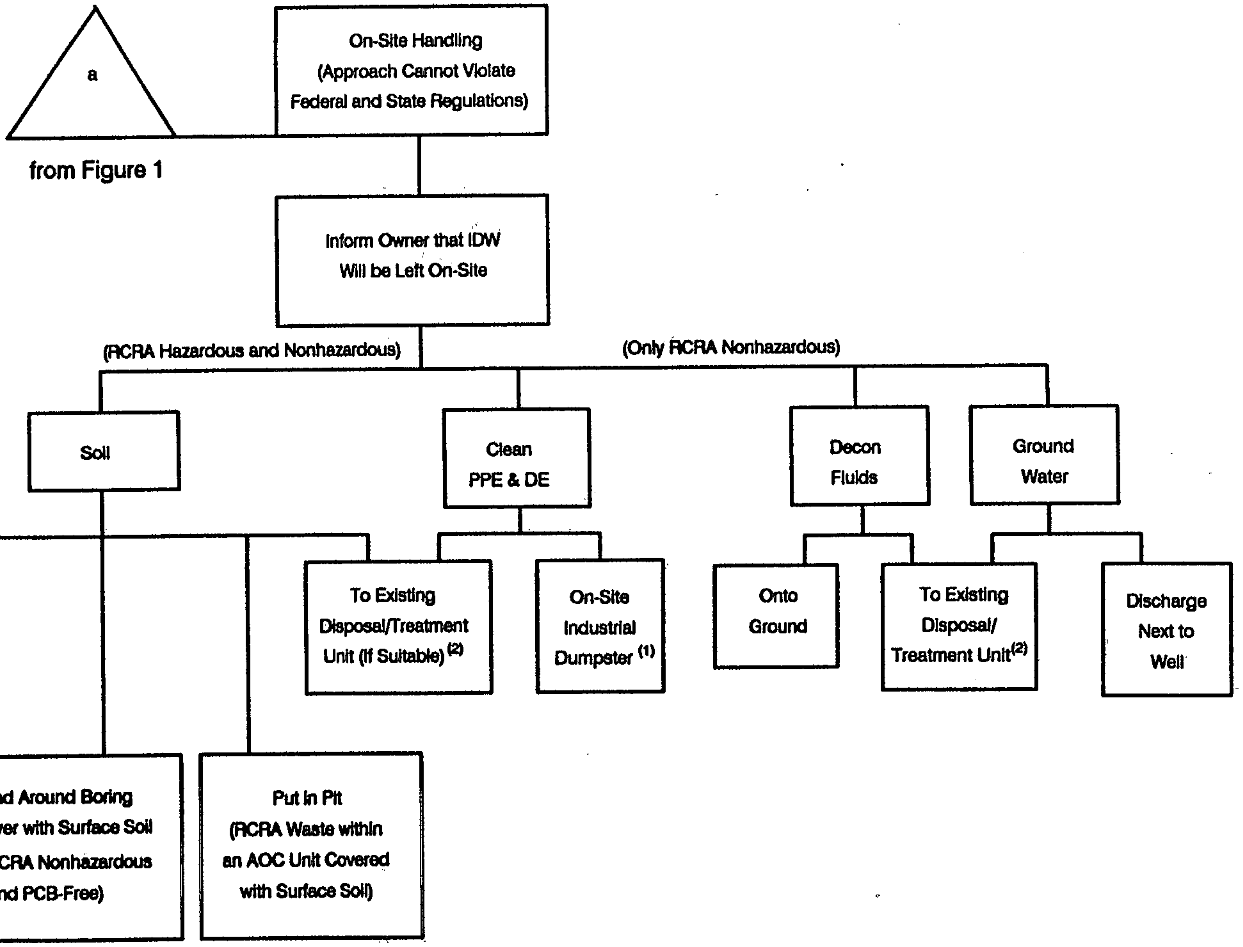
(1) Soil cuttings, ground water, and decontamination fluids creating increased hazards at the site should be disposed off-site. Before and after the SI, determine anticipated waste quantity and applicable regulations for waste generators.

(2) If not prohibited by other legally enforceable requirements such as state ARARs.

(3) Justified only in rare circumstances when a RCRA nonhazardous waste is a state hazardous waste and state legally enforceable requirements call for waste removal, or if leaving the waste on-site would significantly affect human health and the environment.

Figure 2

IDW Management Decision Tree

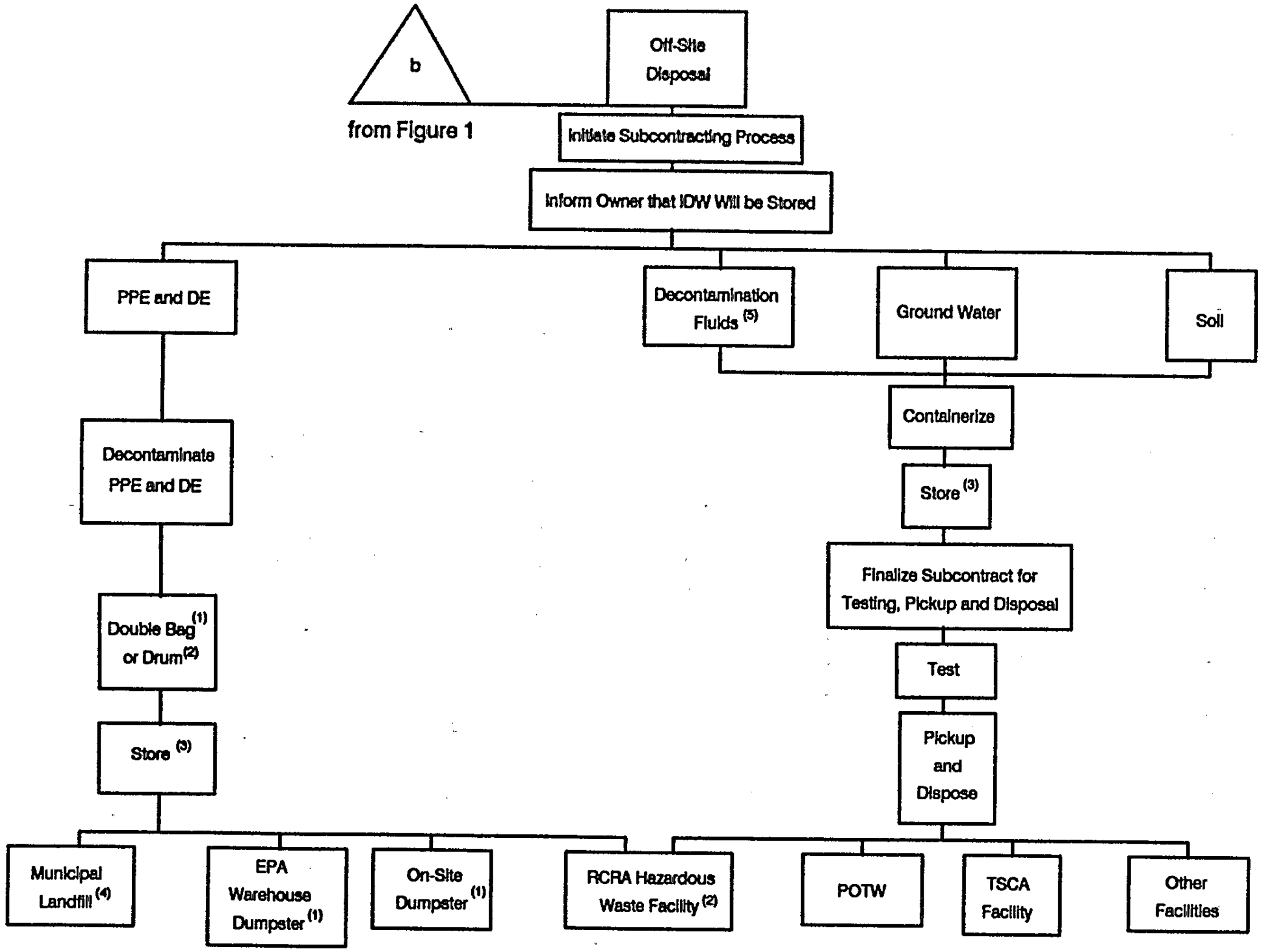


(1) Clean PPE and DE may also go to the nearest landfill or to an EPA warehouse dumpster.

(2) If the receiving unit meets the off-site policy acceptability criteria.

Figure 3

IDW Management Decision Tree



(1) Only RCRA nonhazardous waste.

(2) Only RCRA hazardous waste generated in quantities greater then 100 kg/month when sent off-site.

(3) In accordance with accumulation requirements for RCRA hazardous wastes.

(4) Only if the conditionally exempt small quantity generator exception applies.

(5) If the conditionally exempt small quantity generator exception applies, off-site disposal of decon fluids may not require subcontracting.

ATTACHMENT B [Revised 08/06/2021]
SOP Number: 02-04-08

GUIDE TO MANAGEMENT OF INVESTIGATION-DERIVED WASTES

EPA

United States
Environmental Protection
Agency

Office of
Solid Waste and
Emergency Response

Publication: 9345.3-03FS
April 1992

Guide to Management of Investigation-Derived Wastes

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

CERCLA field investigation activities (e.g., remedial investigation/feasibility studies and remedial designs) may result in the generation of waste materials that may pose a risk to human health and the environment. These investigation-derived wastes (IDW) may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues (e.g., ash, spent carbon, well development purge water) from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment. The management of IDW must ensure protection of human health and the environment and comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARAR). **This fact sheet presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.**[1]

The general options for managing IDW (see **Highlight 1**) are collection and either (1) immediate disposal or (2) some type of interim management. Interim management may include storage or other temporary measures. As discussed below, the specific option selected will depend on the type of waste produced, its relative threat to human health and the environment, and other site-specific conditions.

IDW MANAGEMENT REQUIREMENTS

When managing IDW, site managers are required to choose an option that: (1) is protective of human health and the environment and (2) complies with (or waives) ARARs, as described below.

Protectiveness

In determining if a particular management/disposal option is protective, site managers should consider the following:

- The contaminants, their concentrations, and total volume of IDW;
- Media potentially affected (e.g., ground water, soil) under management options;
- Location of the nearest population(s) and the likelihood and/or degree of site access;
- Potential exposures to workers; and
- Potential for environmental impacts.

As a general rule, it will be necessary to use best professional judgment, in light of the site-specific conditions, to determine whether an option is protective of human health and the environment. For example, a site manager may determine that storing IDW temporarily until the final action or returning IDW to its source is protective, based on knowledge that the material poses low risk and/or that the final action will address any risks posed by the wastes and there will be no unacceptable risks in the interim.

Alternatively, if the site includes or is near residential areas, the site is unsecured, and/or contaminants appear to be present at unacceptable levels, it may not be protective to return excavated soil to the source. Storing IDW in containers in an on-site, secure location, or sending it off site immediately may be more appropriate.

Site managers also need to consider the potential effects of IDW management-related activities on environmental media. For example, pouring contaminated purge water on the ground around a well may not be prudent, because such an action could mobilize any hazardous constituents present in the soil or introduce contaminants into clean soil.

Compliance with ARARs

Remedial Investigation/Feasibility Study (RI/FS) and Remedial Design (RD) actions must comply with ARARs "to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756, emphasis added); therefore, it generally will not be necessary to obtain a waiver if an ARAR cannot be attained during these actions. If a site manager determines that, based on site-

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[1] Management of treatability study and treatment pilot wastes is discussed in Guide for Conducting Treatability Studies Under CERCLA, Interim Final, December 1989, EPA/540/2-89/058. Information on management of IDW generated during Preliminary Assessments and Site Investigations is provided in Management of Investigation-Derived Waste During Site Investigations, May 1990, EPA/540/G-91/009.

Highlight 1: IDW MANAGEMENT OPTIONS

Type of IDW	Generation Processes*	Management Options
Soil	• Well/test pit installation • Borehole drilling • Soil sampling	• Return to boring, pit, or source immediately after generation • Spread around boring, pit, or source within the AOC+ • Consolidate in a pit (within the AOC) • Send to on-site TDU+ • Send to TDU off site immediately • Store for future treatment and/or disposal
Sludges/sediment	• Sludge pit/sediment sampling	• Return to boring, pit, or source immediately after generation • Send to on-site TDU • Send to TDU off site immediately • Store for future treatment and/or disposal
Aqueous liquids (ground water, surface water, drilling fluids, other wastewaters)	• Well installation/development • Well purging during sampling • Ground water discharge during pump tests • Surface water sampling	• Discharge to surface water • Pour onto ground close to well (non-hazardous waste) • Send to on-site TDU • Send to off-site commercial treatment unit • Send to POTW+ • Store for future treatment and/or disposal
Decontamination fluids	• Decontamination of PPE+ and equipment	• Send to on-site TDU • Evaporate (for small amounts of low contamination organic fluids) • Send to TDU off site immediately • Store for future treatment and/or disposal
Disposable PPE	• Sampling procedures or other on-site activities	• Send to on-site TDU • Place in on-site industrial dumpster • Send to TDU off site immediately • Store for future treatment and/or disposal

* The generation processes listed here are provided as examples. IDW may also be produced as a result of activities not listed here.

\+ AOC: Area of Contamination (AOCs at a site may not yet have been identified at the time of the RI/FS); TDU: Treatment/disposal Unit; POTW: Publicly Owned Treatment Works; PPE: Personal Protective Equipment specific factors, compliance with an ARAR is practicable but an ARAR waiver is warranted for an RI/FS or RD action, an interim action waiver may be available if the final remedy will attain the ARAR. An action memorandum should be prepared for the waiver, the state given an opportunity to comment, and the decision document placed in the administrative record.

Potential ARARs for IDW at CERCLA sites include regulations under the Resource Conservation and Recovery Act (RCRA) (including both Federal and State underground injection control (UIC) regulations), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and other State environmental laws. How these various requirements may direct or influence IDW management decisions is described below.

Resource Conservation and Recovery Act (RCRA). Certain sections of the RCRA Subtitle C hazardous waste regulations (e.g., land disposal restrictions and storage restrictions) may be ARARs for IDW should RCRA hazardous waste be identified at a site. (Note that RCRA may be relevant and appropriate even if the IDW is not a RCRA hazardous waste.) A waste is hazardous under RCRA if it is listed as such in 40 CFR 261.31 - 261.33 or if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Site managers should not assume that a waste considered to pose a potential risk at a CERCLA site is a listed or characteristic RCRA hazardous waste. **Until there is positive evidence (records, test results, other knowledge of waste properties) that the IDW is a RCRA hazardous waste, site managers should manage it in a protective manner (but not necessarily in accordance with Subtitle C requirements).** Business records or facility processes should be examined to determine whether RCRA listed wastes were generated and are present in the IDW. For characteristic wastes, site managers should rely on testing results or on knowledge of the material's properties. If best professional judgment and available information indicate that, for protectiveness reasons (or because RCRA requirements are relevant and appropriate), IDW is best managed as a "hazardous waste," management in accordance with Subtitle C requirements is prudent, regardless of whether it is known to be a RCRA waste.

If aqueous liquid IDW is considered a RCRA hazardous waste, the site manager should determine whether the Domestic Sewage Exclusion (DSE) applies to the discharge of that IDW to a POTW. The RCRA DSE exempts domestic sewage and any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment from classification as a solid waste and, therefore, as a RCRA hazardous waste (40 CFR 261.4).

- Land Disposal Restrictions

If IDW is determined to be a RCRA hazardous waste and subject to the land disposal restrictions (LDRs), "land disposal" of the IDW will be prohibited unless specified treatment standards are met (see Superfund LDR Guides #5 and #7, Determining When LDRs Are Applicable to CERCLA Response Actions and Determining When LDRs Are Relevant and Appropriate to CERCLA Response Actions, OSWER Directive 9347.3-05FS and 9347.3-08FS, June 1989 and December 1989 and the NCP, 55 FR 8759, March 8, 1990). "Land disposal" occurs when wastes from different AOCs are consolidated into one AOC; when wastes are moved outside an AOC (for treatment or storage) and returned to the same or a different AOC; or when wastes are excavated, placed in a separate hazardous waste management unit such as an incinerator or tank within the AOC, and then redeposited into the AOC.

Storing IDW in a container ("a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled" (40 CFR 260.10)) within the AOC and then returning it to its source, however, is allowable without meeting the specified LDR treatment standards. Under the definition of "hazardous waste management unit" (40 CFR 260.10), EPA states that "a container alone does not constitute a unit; the unit includes the containers and the land or pad upon which they are placed." Therefore, returning IDW that has been stored in containers (not tanks or other RCRA-regulated units) within the AOC to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of wastes within an AOC do not constitute land disposal.

- Storage

Subtitle C outlines the storage requirements for RCRA hazardous wastes. Under RCRA, "storage" is defined as "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR 260.10).

On-site Superfund actions are only required to comply with the substantive standards of other laws (see 40 CFR 300.5, definitions of applicable or relevant and appropriate requirements). Superfund sites are also exempt from permit requirements under CERCLA §121(e). Therefore, site managers are not required to comply with administrative requirements triggered by RCRA storage deadlines (e.g., contingency planning, inspections, recordkeeping). Generally equivalent administrative activities are undertaken at Superfund sites, however, under existing Superfund management practices.

Site managers storing known RCRA hazardous waste must comply with the substantive, technical requirements of 40 CFR Parts 264 and 265 Subparts I (containers), J (tanks), and L (waste piles), to the extent practicable. (See **Highlight 2** for a summary of these technical requirements for each type of unit). In addition, the ground-water monitoring requirements of 40 CFR Parts 264 and 265 Subpart F are potential ARARs, and to the extent they are determined to be ARARs at a site, they should be attained to the extent practicable (or waived). (In many cases, ground-water monitoring conducted during the RI/FS will provide protection equivalent to the Subpart F requirements.)

[NOTE: Under the LDRs, restricted RCRA hazardous waste may not be stored at a site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal, treatment, or recovery (see 40 CFR 268.50). **Generally, storing IDW until a final disposal option is**

Highlight 2:
EXAMPLES OF RCRA TECHNICAL STORAGE REQUIREMENTS*

RCRA storage requirements, applicable to both less-than-90-days generators and permitted or interim status storage facilities, may include the following substantive requirements:

<u>Containers</u> 40 CFR 264 Subpart I and 265 Subpart I

- Containers must be in good condition
- Wastes must be compatible with container
- Container must be closed during storage
- Container storage areas must have a containment system that can contain 10 percent of the volume of containers or of the largest container
- Spilled or leaked waste must be removed from the collection area as necessary to prevent overflow

<u>Tanks</u> *40 CFR 264 Subpart J and 265 Subpart J*

- Tanks must have a secondary containment system that includes a liner, a vault, a double-walled tank, or an equivalent device (applies only to certain tanks)

<u>Waste Piles</u> 40 CFR 264 Subpart L and 265 Subpart L

- Waste piles must have a liner and a leachate collection and removal system
- Owners/operators must have a run-on control system to prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm
- Owners/operators must have a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm

* This is a <u>partial</u> list of substantive requirements. For more detail, see 40 CFR Part 264 and 265.

selected in a Record of Decision (ROD) and implemented during the remedial action is allowable storage under the RCRA LDR storage prohibition.]

- <u>Recordkeeping and Manifesting</u>

If hazardous wastes are sent off site, the site manager must comply with both administrative and substantive elements of the RCRA generator requirements of 40 CFR Part 262 and LDR notification and certification requirements of Part 268. (For example, a site manager must prepare an LDR notification and certification when restricted wastes are sent off site to a land disposal facility.) These standards include requirements such as manifests for shipping waste that list <u>all</u> hazardous waste listings and characteristics applicable to the waste (see 40 CFR 262.11), packaging and transport requirements, and recordkeeping requirements.

If the LDRs are applicable, the following information should be collected and available before the removal of wastes to an off-site disposal facility: EPA hazardous waste number, LDR treatment standards, manifest number for the waste shipment, and waste analysis data.

- <u>Underground Injection Control (UIC) Program</u>

Under the UIC regulations, RCRA hazardous wastes may be injected into Class I permitted wells. In some cases, hazardous liquids, such as extracted ground water from pump and treat operations, may be injected into a Class IV UIC well. For example, ground water contaminated with RCRA hazardous wastes may be injected into Class IV permitted wells if it is part of a CERCLA response action or a RCRA corrective action and if it has been treated to "substantially reduce hazardous constituents prior to such injection..." (RCRA § 3020(b)). (See <u>Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection</u>, OSWER Directive #9234,1-06, December 1989.)

- <u>Non-RCRA Hazardous Wastes</u>

Some non-RCRA hazardous waste may be subject to management requirements under Subtitle D of RCRA as solid wastes. Subtitle D regulates disposal of solid waste in facilities such as municipal landfills. Therefore, non-RCRA hazardous IDW, such as decontaminated PPE or equipment, may need to be disposed of in a Subtitle D facility (depending on State requirements).

Clean Water Act (CWA). Discharges of aqueous IDW to surface water and publicly owned treatment works (POTWs) may be required to comply with CWA Federal, State, and local requirements. Requirements to be met may include water quality criteria, pre-treatment standards, State water quality standards, and NPDES permit conditions. Direct discharges to on-site waters are subject only to substantive requirements, while discharges to POTWs and other off-site discharges must comply with both substantive and administrative CWA requirements (including permitting requirements). (See <u>Guide to Discharging CERCLA Aqueous Wastes to POTWs</u>, June 1991 and <u>CERCLA Compliance with the CWA and SDWA</u>, #9234.2-06FS, January 1991.)

Toxic Substances Control Act (TSCA). If IDW contains PCBs, TSCA treatment and/or disposal requirements may apply during its management. TSCA requirements regulate the disposal of material contaminated with PCBs at concentrations of 50 ppm or greater as found on site (i.e., based on sample analysis and not the PCB concentration of the source material {e.g., transformer fluid}). (See <u>PCB Guidance Manual</u>, EPA/540/G-90/007, August 1990.) In addition, TSCA storage requirements may apply that limit the time that PCBs may be stored to one year. Furthermore, if PCB materials are mixed with a RCRA hazardous waste, they may be regulated by the LDR California list prohibitions. (See RCRA sections 3004(d)(2)(D) and (E).)

Department of Transportation (DOT) requirements. Where IDW will be disposed of off site or transported on public roads to a site, DOT requirements for containerizing, labeling, and transporting hazardous materials and substances may apply.

State requirements. Promulgated State regulations that are legally enforceable, timely identified, and more stringent than Federal regulations may be potential ARARs for IDW managed on site. Substantive requirements of State law that may be ARARs for IDW management include State water quality standards, direct discharge limits, and RCRA requirements (including underground injection control regulations) promulgated in a State with an authorized RCRA hazardous waste management program (as well as programs authorized by State laws). Off-site, substantive and administrative requirements of State law may apply.

Off-Site Policy. In addition to complying with requirements of Federal and State laws, all off-site disposal of wastes must comply with CERCLA section 121(d)(3) and the CERCLA Off-Site Policy (OSWER Directive No. 9834.11 (November 13, 1987)). The Off-Site Policy establishes criteria for selecting an appropriate treatment, storage, or disposal facility (TSDF), including release criteria for all facilities that receive wastes from CERCLA-authorized or funded response actions. In addition, receiving facilities must be in compliance with all "applicable laws."

Before shipping wastes off site, approval should be obtained for the proposed disposal facility from EPA's Regional Off-Site Policy Coordinator. In addition, EPA has adopted a policy for Superfund wastes shipped out of State that written notification should be provided to receiving States (OSWER Directive 9330.2-07, September 14, 1989).

GENERAL OBJECTIVES FOR IDW MANAGEMENT

In addition to the two requirements of protectiveness and compliance with ARARs to the extent practicable (on site) or compliance with applicable law (off site), EPA has identified two general objectives that Superfund site managers should consider when managing IDW: (1) minimization of IDW generation; and (2) management of IDW consistent with the final remedy for the site. The extent to which these objectives can be achieved is highly dependent on site-specific circumstances.

IDW Minimization

Site managers should strive to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information from the site inspection. The potential problems of managing IDW should be a factor in choosing an investigative method. Site managers may wish to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between clean and hot zones, and drilling methods and sampling techniques that generate little waste. Examples of such techniques include using gridding techniques to minimize the number of test pits or using soil borings instead of test pits. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer instead of coring. Site managers should also be careful to keep hazardous wastes separate from nonhazardous wastes.

Management Consistent with Final Remedy

Most IDW (with the exception of non-indigenous IDW) generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements.

Because early planning for IDW management can prevent unnecessary costs and the use of treatment or disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated/disposed of immediately or addressed with the final remedy. If addressed with the final remedy, IDW volumes should be considered in the FS. In addition, when IDW is stored on site, it should be managed as part of the first remedial action/operable unit that addresses the affected media.

SELECTION OF IDW DISPOSAL OPTIONS

The following sections present the Agency's presumptions for IDW management that have been established based on the above considerations. The actual option selected should be based upon best professional judgment and should take into account the following factors:

- The type and quantity of IDW generated (sludge/soil, aqueous liquid, non-indigenous IDW);
- Risk posed by managing the IDW on site (e.g., based on site access controls, contaminant concentrations);
- Compliance with ARARs, to the extent practicable (on site);
- IDW minimization; and
- Whether the final remedy is anticipated to be an off-site or on-site remedy (or this information is unknown) and whether IDW can be managed consistent with the final remedy.

Off-site Final Remedies

If a site manager believes that the final remedy will involve off-site disposal of wastes, EPA's presumption is to manage the IDW as part of the remedial action addressing the waste/medium. Thus, until the final action, the IDW may be stored (e.g., drummed, covered waste pile) or returned to its source. However, the management option selected should also take into account any protectiveness concerns, ARARs, and other relevant site-specific factors (e.g., weather, storage space, and public concern/ perceptions).

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site will be shipped off site eventually, returning IDW (especially sludges and soil) to its source would require that it be excavated again. Thus, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

Off-site Remedy

Example: A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

On-site Final Remedies (or Final Management in an Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. **Storage of RCRA hazardous IDW in containers within the AOC prior to returning it to the source will not trigger the LDRs, as long as the containers are not managed in such a way as to constitute a RCRA storage unit as defined in 40 CFR 260.10.** Therefore, it may be possible to store IDW temporarily before redisposing of it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately vary from the presumption based on protectiveness, ARARs, and/or community concerns.

Sludge/Soil

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secure and that redisposing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas) and that the contamination will be addressed in the final remedy.

Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquids on a **site-specific** basis. Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components. Examples of aqueous liquid management decisions considering these factors are presented in the box on the next page.

Non-indigenous IDW

Non-indigenous IDW (e.g., sampling materials, disposable PPE, decontamination fluids) should be stored until the final remedy or disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would add contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If non-indigenous IDW is contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise, site

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
02-04-05	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
02-04-06	1/1/2020	Reviewed and updated, changed company name to TechLaw Consultants, Inc.
02-04-07	12/22/2020	Reviewed and updated, added information on general trash/scraps and solid/hazardous waste characterization
02-04-08	08/06/2021	No changes to SOP content. Publications in Attachment A and Attachment B were removed from word file and inserted in pdf document to address clarity.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

FIELD PROCEDURES –
CHAIN OF CUSTODY

Page 1 of 10
SOP Number: 02-05-06
Effective Date: 1/1/2020

Technical Approval: ________________ Date: 1/1/2020

QA Management Approval: David E. Dobb Date: 1/1/2020

SOP Description

This Standard Operating Procedure (SOP) describes the steps that are to be taken to ensure a correct Chain-of-Custody (COC) program is followed for every TechLaw Consultants project involving sampling activities. The program allows for the tracking of possession and handling of individual samples, from the time of field collection through laboratory analysis. Because samples collected during an investigation could be used as evidence in litigation, possession of the samples must be traceable from the time each sample is collected until analytical results are introduced as evidence in legal proceedings.

This SOP must be used in conjunction with the procedures for packaging and shipping samples as discussed in SOP No. 04-02-XX, Environmental Samples, and SOP No. 04-03-XX, Hazardous Materials/Dangerous Goods.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures

08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI SOPs

Equipment and Apparatus

- Sample identification labels to attach to sample containers
- Custody seals
- COC form
- Receipt for Samples forms
- Ice chests and ice for sample shipment
- Clear (packing/strapping) tape
- Plastic sealable storage bags
- Pens with indelible ink
- Large trash bags to line the ice chest (cooler)
- Packaging materials (e.g., bubble wrap, packing peanuts etc.)

Additional equipment and apparatus when using Scribe

- Computer, preferably with internet access
- Three-in-one portable printer
- Sticker labels for printing (such as Avery labels for printing)

Definitions

Sample under Custody

A sample is considered to be "under custody" if one or more of the following criteria are met:

- The sample is in the sampler's or the transferee's actual possession,
- The sample is in the sampler's or transferee's view after being in his/her possession,
- The sample was in the sampler's or transferee's possession and then was locked up in a secure place to prevent tampering, and
- The sample is placed in a designated secure area.

Sampler

The sampler is defined as the person responsible for the collection of the samples. Any person on the sampling team may serve as the sampler.

Transferee

The transferee is the person designated to receive and maintain custody of the samples and coordinate shipment of the samples from the site of collection to the analytical laboratory. Any person on the sampling team may serve as the transferee. In addition, the role of the transferee may be filled by several different people throughout the course of the sampling activities. The basic function of the transferee is to assume the responsibility of custody of the samples from the time the samples are collected until they are relinquished to the shipping company or the analytical laboratory.

Description of Chain-Of-Custody Forms

The COC process requires that specific COC forms and paperwork be prepared to document custody of the samples, from the time they are collected in the field until received by the analytical laboratory. A brief description of each of the forms and/or paperwork follows:

- **Sample Identification Label** – A sample identification label is affixed to each sample container to prevent misidentification of the samples after collection. The labels are usually self-adhesive and are affixed to the sample containers by placing them directly on the container exterior. Information to be provided on each label includes the site identification[1], date, time, preservative used (if any), type of analysis to be performed, initials of the sampler, and sample control number. The information should be recorded using indelible ink. The sample labels can be affixed to the sample containers either immediately before or after the sample collection activities. However, care must be taken to ensure that the containers are not mislabeled if the labels are applied after the samples are collected. The label on the bottle should be taped over with transparent tape to prevent the label from falling off if exposed to water from melting ice.

  Sample identification labels are usually provided along with the shipment of sample containers, however, they can also be purchased separately. Sample containers and labels may be acquired from either the laboratory contracted to perform the analytical work, or from an independent source. Examples of sample identification labels are provided in Attachment A.

- **Sample Tag** – Sample tags are rarely used anymore for field sample identification. If used, requirements for using sample tags will be discussed in the QAPP or SAP. A

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[1] ***Under no circumstances is it acceptable to provide the laboratory with the name, location or other identifying information for the site (this <u>includes</u> listing facility information on the chain-of-custody).*** Facility codes or initials, TechLaw project number or other identifiers should be used that will not reveal facility information to the laboratory, but will be evident to TechLaw Consultants employees involved with the project.

sample tag consists of an identification label which is tied to the neck of the sample container. Information to be provided on each sample tag includes the project code, sample station number, the date and time of sample collection, type of sample (e.g., grab or composite), sample station location, the samplers' initials or signatures, whether or not a preservative was added, type of analysis to be performed, tag number, and lab sample number. A copy of a sample tag is provided in Attachment B.

- **Custody Seal** – If required by the SAP or QAPP, a custody seal is affixed over each sample container and lid to provide evidence that the sample was not tampered with during transport to the analytical laboratory. The custody seals are self-adhesive and should be placed such that they cover the sample containers and lids and sample tag strings, but not the writing on the sample labels. The custody seals may contain the date and signature of the sampler; provide space to include the sample number; the name of the individual who breaks the seal; and, the date that the seal is broken. Care must be taken to ensure that all sample identification characters are transcribed correctly on all related documents. Custody seals are also used to secure the sample shipping containers and lids. Examples of custody seals are provided in Attachment C.

- **Chain-of-Custody Record** – A COC Record is used to track and document sample possession from the time of collection until receipt at the analytical laboratory. A completed form must be filled out to accompany each shipment of samples to the laboratory. Information to be recorded on the form may include: the project number, project name[2]; name and address of analytical laboratory; samplers' names and signatures; date and time of sample collection; sample identification numbers; sample description; type of preservative; grab or composite; number of containers included in the shipment; analytical parameters requested; and, sample tag number (if applicable). The bottom portion of the form contains blocks for the signatures of the persons involved in the chain of possession, including dates of possession, and any pertinent remarks. A copy of a COC Record form is provided in Attachment D.

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[2] ***Under no circumstances is it acceptable to provide the laboratory with the name, location or other identifying information for the site (this includes listing facility information on the chain-of-custody).*** Facility codes or initials, TechLaw Consultants project number or other identifiers should be used that will not reveal facility information to the laboratory, but will be evident to TechLaw Consultants employees involved with the project.

- **Receipt For Samples Form** – RCRA Section 3007 and CERCLA Section 104 require that a "receipt" for all facility samples collected during inspections and investigations be given to the owner/operator of each facility before the field investigator departs the premises. A Receipt For Samples form may be used to satisfy these requirements. In addition, the form may also be used to document that split samples were offered to, and were accepted or rejected by, the owner/operator of the facility, as well as documenting this in the field logbook or electronic data collection device. A COC Record may also be used to document the collection of split samples and may substitute for the Receipt for Samples form. Information to be entered on the form includes: the project number and name; facility name and location; samplers' signatures; sample station number and description; date and time of sample collection; type of samples collected (e.g., groundwater or soil; grab or composite); sample tag numbers; number of containers; any pertinent remarks; and the signatures of the persons involved in the chain of possession. A copy of a Receipt for Samples form is included as Attachment E.

Chain-of-Custody Procedures

The field sampling team is responsible for the care and custody of all field samples from the time of collection until shipment to the analytical laboratory. The specific COC procedures to be followed for each sampling event are listed below.

- The sampling team should collect samples in the field such that the most sensitive parameters are addressed before the less sensitive parameters (e.g., volatile organic samples should be collected prior to metals, cyanide, and other parameters). Refer to the SOP "06-," "07-," and "08-," "12-", and "13-" series for specific sampling procedures for groundwater, soil/sediment, surface water, incineration/BIF, and waste, respectively.

- Each sample container should be filled with the sample, and then placed in an ice chest which contains bagged ice.[3] All environmental sample containers must be placed in the ice chest immediately after collection to preserve the integrity of the sample parameters. The ice chest with the samples must remain in view of the samplers in order for the samples to remain in custody. If this is not possible, for example, in remote areas or small sampling teams, the samples must be kept in a secure place such as a locked

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[3] Only environmental samples should be preserved with ice; waste samples are never shipped with ice. Refer to SOP No. 04-02-XX for more information regarding the packaging and shipping procedures for environmental samples

vehicle for the entire time period they are out of view. Samples collected at a remote location may have to be preserved, labeled and the COC filled out when returning to the field vehicle then placed on ice in a cooler and the cooler stored in a secure place (i.e., vehicle that can be locked).

- After all sample parameters have been collected at a specific sample location, the sampling team travels back to the central staging area, relinquishes control of the samples to the transferee for safekeeping, and prepares for the next sampling location. If only two field samplers are present, samples must be placed on ice and locked in a secure location (e.g., vehicle) before departing for the next sample location. Sometimes samplers may visit all sampling locations for the day holding samples on ice in coolers then report to the staging area at the end of the day to finish reconciliation. During the reconciliation process an assessment of the integrity of the samples is done and a determination made if re-sampling needs to occur or the need for further documentation.

- The transferee (or other field team members, as appropriate) should inspect the sample containers to ensure they were properly filled and secured. Any problems observed with the sample containers (e.g., broken glass containers, sample bottles not adequately filled, loose lids) should be completely documented in the field logbook. Affected samples should be recollected.

- If not already affixed, the transferee/field team members should apply sample identification labels and/or sample tags to the sample containers. A layer of clear (packing/strapping) tape may be placed directly over each sample label to prevent the ink from smearing and slippage of the label due to condensation on the outside of the container. After the sample containers have been labeled/tagged, the transferee may secure each sample with custody seals. Samples are then placed into plastic resealable bags. Large sample containers (e.g., one-gallon amber glass jugs) do not need to be placed into plastic bags. The sample containers are then returned to the ice chest.

- After samples have been collected and the containers appropriately labeled, the transferee then completes the COC Record. If necessary, the transferee and/or sampling team members transfer the sample containers from the sample storage ice chest into the sample shipping container (which may be a different ice chest). The transferee/team members must ensure that the samples are properly packaged within the shipping container. Refer to SOP No. 04-02-XX for sample packaging and shipping procedures.

- The original and at least one copy of the COC Record must be placed inside a plastic resealable storage bag and taped to the underside (interior) of the shipping container lid. One copy of the COC Record must be retained by the transferee for placement into the project files.

- The sample shipping container should then be closed and secured with several layers of strapping tape at each end of the shipping container. At least two custody seals must be placed along the front and back edges of the container, where the container body and lid meet. The custody seals should be affixed such that the shipping container cannot be opened without tearing or disturbing the seals. Secure the seals by covering them with tape. The seals should be secured to prevent their accidental removal during shipment. Only one layer of tape should cover the seals to ensure that they remain visible through the tape. Note that custody seals are not necessary if we are transporting the samples ourselves and analysis is being done in-house.

- The shipping airbill should then be completed and attached to the shipping container. The transferee (or other sample team member as designated by the transferee) must personally deliver and release the shipping container to the shipping company or the analytical laboratory.

- If it is not possible to release the sample shipment to the shipping company, or if the samples must be retained overnight, the transferee or designated custodian must maintain custody of the samples until the shipment can be accomplished. Custody is maintained provided that the samples:

    - Remain in the transferee’s actual possession.
    - Remain in the transferee’s view after being in his/her possession.
    - Are locked up in a secure place to prevent tampering.
    - Are placed in a designated secure area.

  If the shipping delay is of a short duration (less than twenty-four hours in most circumstances), the shipping container should remain closed and sealed. The actual release time to the shipping company should then be entered in the field logbook or electronic data collection device. If the delay time is of a longer duration, or the conditions where the samples are stored are likely to lead to loss of ice (i.e., if the samples are kept in a locked vehicle on a hot day), the shipping container should be re-opened and additional ice added to the container. In addition, the laboratory should be contacted and informed of any pending shipping delays.

- Prepare a Receipt For Samples form or a COC form and present it to the facility representative prior to departing the facility. Document in the field logbook whether split samples were offered to, and were accepted or rejected by, the facility representative. The transferee must keep one copy of the Receipt For Samples form or COC form for inclusion in the project files.

- Document all field sampling and shipping activities, and COC procedures in the field logbook or electronic data collection device and photographic record. In addition, any COC deviations from the SAP or this SOP must be documented and justified in the field logbook. Field logbook and photographic log documentation procedures can be found in SOP Nos. 03-01-XX and 03-02-XX, respectively.

The above COC procedures are guidelines that should generally be followed by TechLaw Consultants field personnel. However, the site-specific SAP and QAPP should identify any specific requirements based on project or contract requirements. For EPA Superfund contracts, it is often necessary to send the samples to a Superfund's Analytical Services Branch (ASB) Contract Laboratory Program (CLP) Routine Analytical Services (RAS). When a CLP lab is the designated recipient of the samples, Scribe should be used to generate labels, COCs and traffic reports (TRs). The use of Scribe is outlined in SOP No. 03-05-XX, Data Management Using the SCRIBE Software Tool.

Health and Safety

It is TechLaw Consultants' policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed safety shoes, and safety glasses. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged items.

A site-specific health and safety plan (HASP) must be developed by the field team leader or designee and approved by the TechLaw Consultants Health and Safety Director prior to implementation in the field. This plan must be reviewed with the field team members prior to beginning work.

Any deviation(s) from an approved site-specific HASP must be documented in the field logbook.

QA/QC

None at this time.

Comments/Notes

None at this time.

Attachments

Attachment A – Sample Identification Labels (examples)

Attachment B – Sample Tag (examples)

Attachment C – Custody Seals (examples)

Attachment D – Chain-of-Custody Record (examples)

Attachment E – Receipt For Samples Form (examples)

References

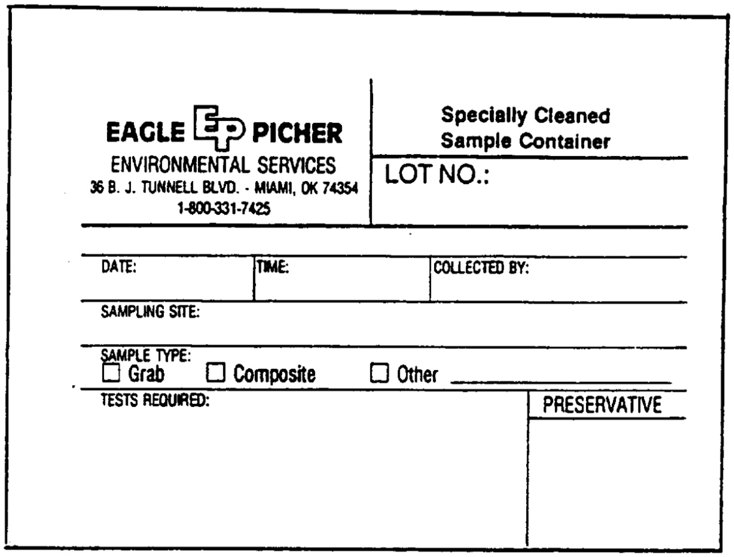
TechLaw Consultants, Corporate Quality Management Plan, current revision.

TechLaw Consultants, Health and Safety Program, current version.

ATTACHMENT A [Revised 1/1/2020]
SOP Number: 02-05-06

SAMPLE IDENTIFICATION LABELS

ATTACHMENT A [Revised 1/1/2020]
SOP Number: 02-05-06



EAGLE PICHER
ENVIRONMENTAL SERVICES
36 B. J. TUNNELL BLVD. - MIAMI, OK 74354
1-800-331-7425

Specially Cleaned
Sample Container

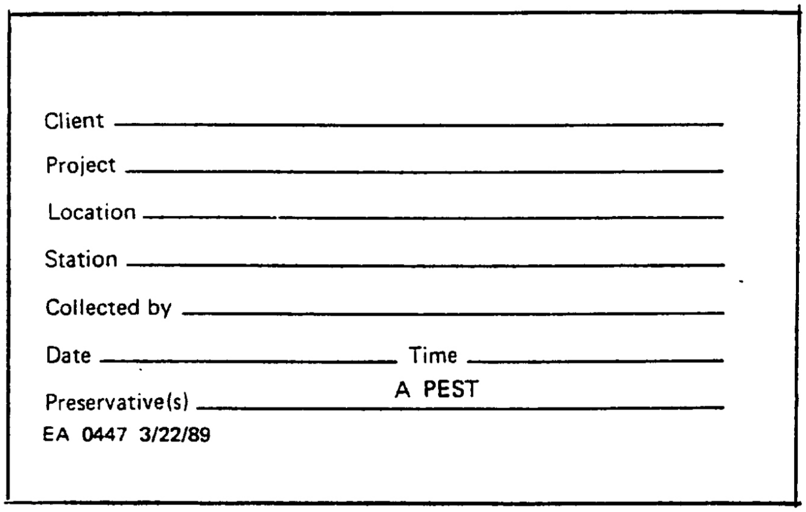
LOT NO.:

DATE:	TIME:	COLLECTED BY:

SAMPLING SITE:

SAMPLE TYPE:
☐ Grab ☐ Composite ☐ Other ______

TESTS REQUIRED:	PRESERVATIVE

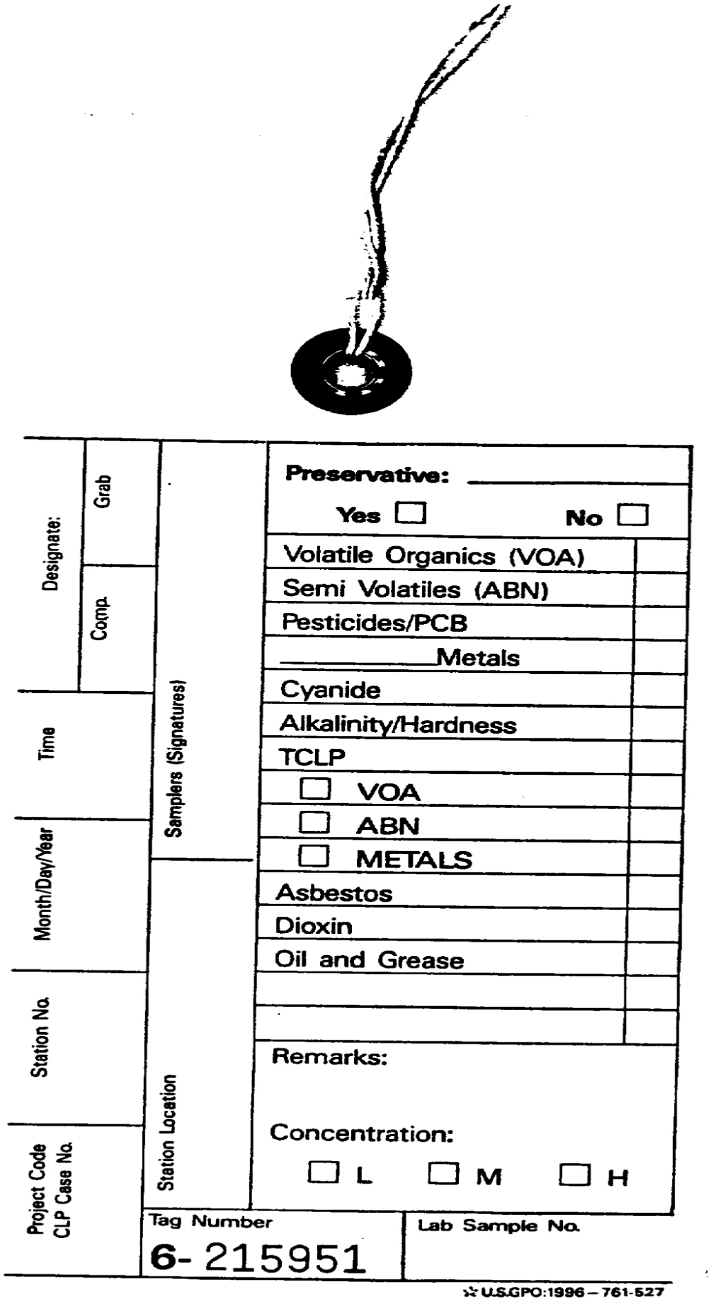


Client ______
Project ______
Location ______
Station ______
Collected by ______
Date ______ Time ______
Preservative(s) ______ A PEST
EA 0447 3/22/89

ATTACHMENT B [Revised 1/1/2020]
SOP Number: 02-05-06

SAMPLE TAG

ATTACHMENT B [Revised 1/1/2020]
SOP Number: 02-05-06



Designate: Grab ☐ Comp. ☐

Time

Month/Day/Year

Station No.

Project Code
CLP Case No.

Samplers (Signatures)

Station Location

Preservative: ____________

Yes ☐ **No** ☐

Volatile Organics (VOA)	
Semi Volatiles (ABN)	
Pesticides/PCB	
__________ Metals	
Cyanide	
Alkalinity/Hardness	
TCLP	
☐ VOA	
☐ ABN	
☐ METALS	
Asbestos	
Dioxin	
Oil and Grease	

Remarks:

Concentration:

☐ L ☐ M ☐ H

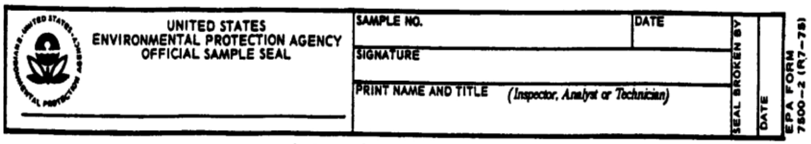
Tag Number
6- 215951

Lab Sample No.

☆ U.S.GPO:1996 – 761-527

ATTACHMENT C [Revised 1/1/2020]
SOP Number: 02-05-06

CUSTODY SEALS



UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO. ____ DATE ____

SIGNATURE ____

PRINT NAME AND TITLE *(Inspector, Analyst or Technician)* ____

SEAL BROKEN BY ____

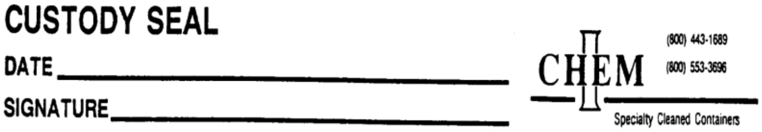
DATE ____

EPA FORM 7500-2 (R7-78)

CUSTODY SEAL

Date ____

Signature ____



CUSTODY SEAL

DATE ____

SIGNATURE ____

CHEM

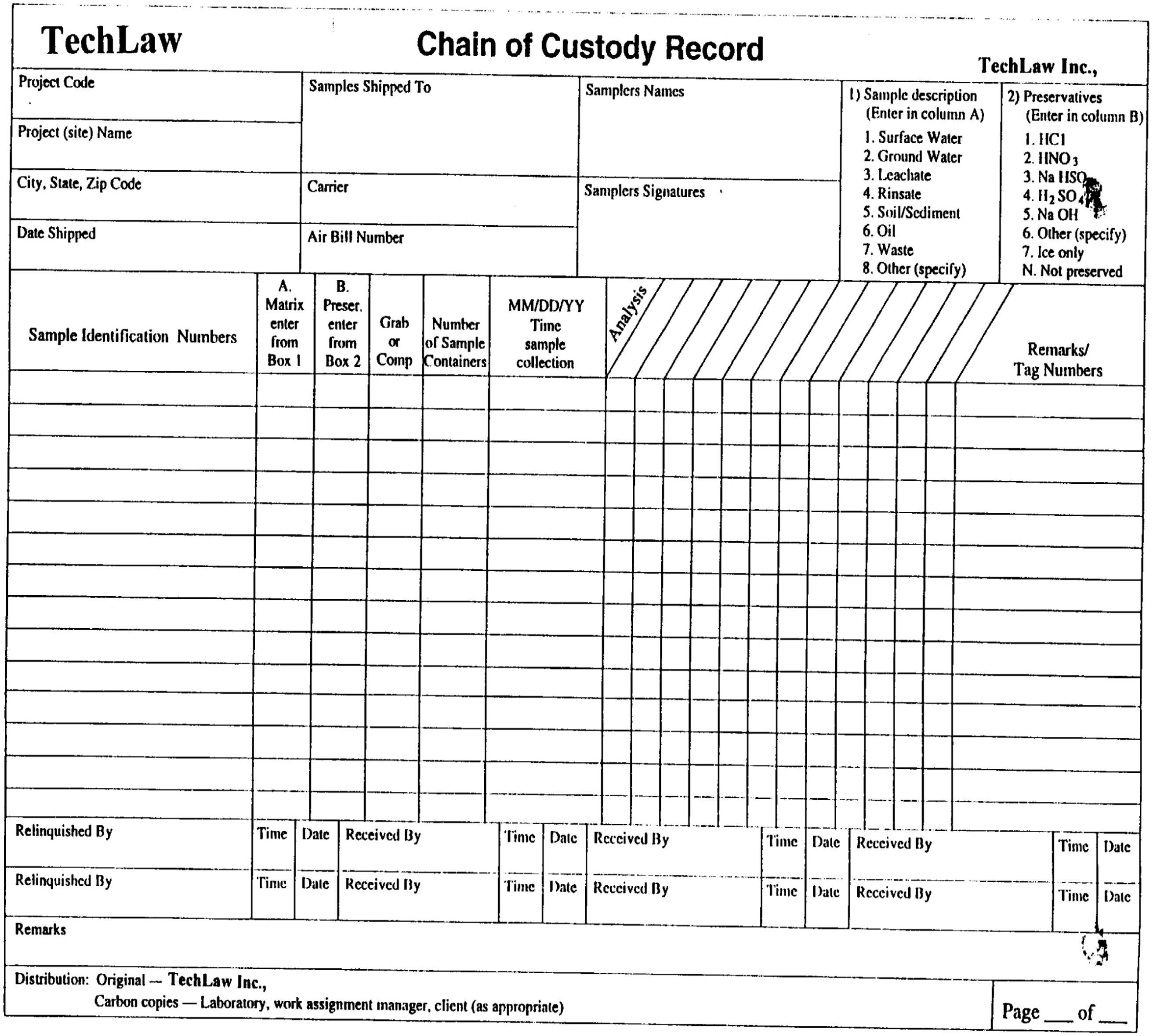
(800) 443-1689
(800) 553-3696

Specialty Cleaned Containers

ATTACHMENT D [Revised 1/1/2020]
SOP Number: 02-05-06

CHAIN-OF-CUSTODY RECORD

ATTACHMENT D [Revised 1/1/2020]
SOP Number: 02-05-06



TechLaw

Chain of Custody Record

TechLaw Inc.,

Project Code	Samples Shipped To	Samplers Names	1) Sample description (Enter in column A) 1. Surface Water 2. Ground Water 3. Leachate 4. Rinsate 5. Soil/Sediment 6. Oil 7. Waste 8. Other (specify)	2) Preservatives (Enter in column B) 1. HCl 2. HNO$_3$ 3. Na HSO$_4$ 4. H$_2$SO$_4$ 5. Na OH 6. Other (specify) 7. Ice only N. Not preserved
Project (site) Name				
City, State, Zip Code	Carrier	Samplers Signatures		
Date Shipped	Air Bill Number			

Sample Identification Numbers	A. Matrix enter from Box 1	B. Preser. enter from Box 2	Grab or Comp	Number of Sample Containers	MM/DD/YY Time sample collection	Analysis												Remarks/ Tag Numbers

Relinquished By	Time	Date	Received By	Time	Date	Received By	Time	Date	Received By	Time	Date
Relinquished By	Time	Date	Received By	Time	Date	Received By	Time	Date	Received By	Time	Date

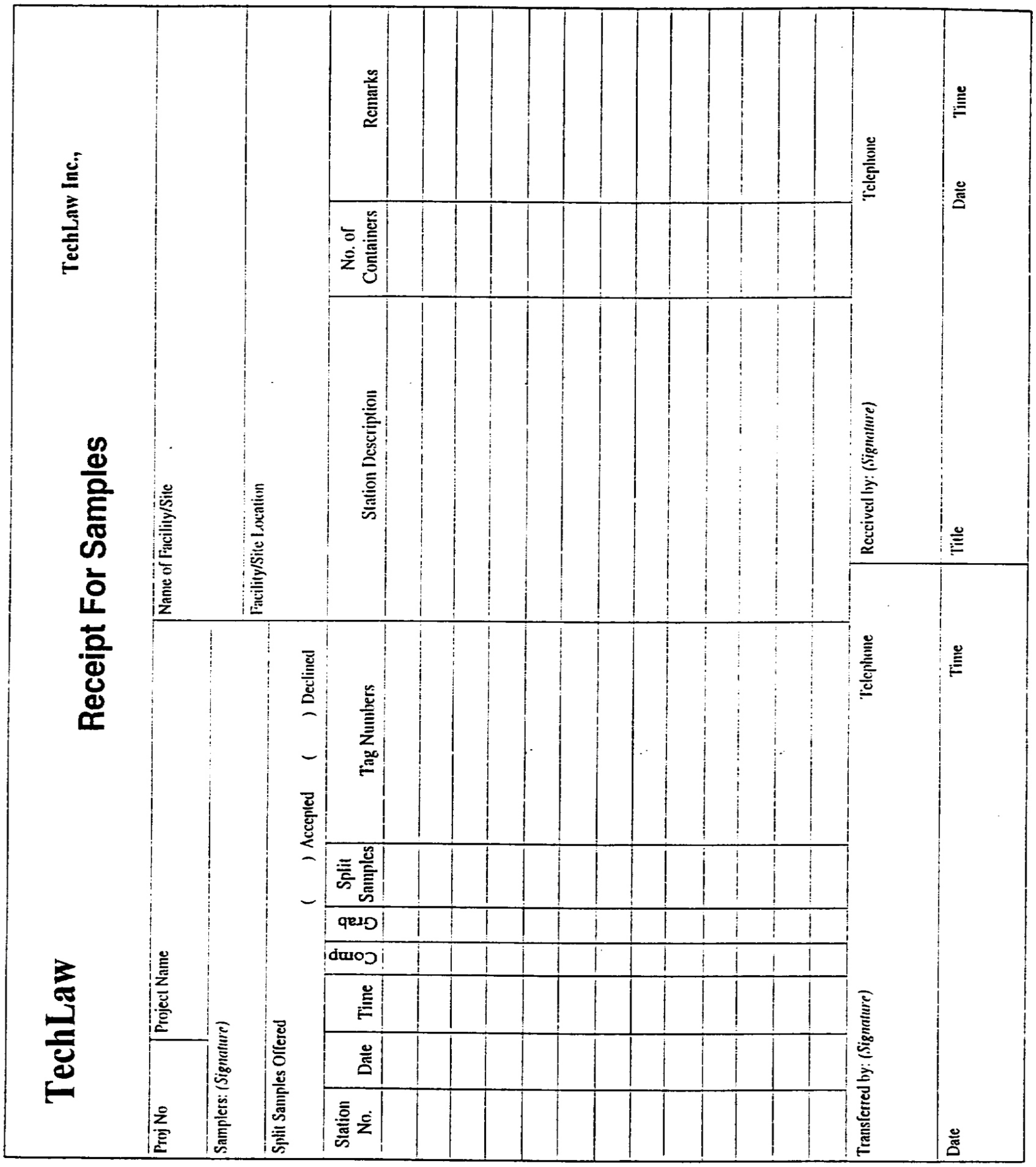
Remarks

Distribution: Original — **TechLaw Inc.,**
Carbon copies — Laboratory, work assignment manager, client (as appropriate)

Page ___ of ___

ATTACHMENT E [Revised 1/1/2020]
SOP Number: 02-05-06

RECEIPT FOR SAMPLES FORM



TechLaw **Receipt For Samples** **TechLaw Inc.,**

Proj No

Project Name

Name of Facility/Site

Samplers: *(Signature)*

Facility/Site Location

Split Samples Offered

( ) Accepted ( ) Declined

Station No.	Date	Time	Comp	Grab	Split Samples	Tag Numbers	Station Description	No. of Containers	Remarks

Transferred by: *(Signature)*

Telephone

Date

Time

Received by: *(Signature)*

Telephone

Title

Date

Time

RECORD OF CHANGES/REVIEW

Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
02-05-05	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
02-05-06	12/21/2017	Reviewed for accuracy, minor changes made throughout. Removed all reference to Forms II Lite as it is not used anymore.
02-05-06	1/1/2020	Changed Company Name to TechLaw Consultants, Inc.

FIELD DOCUMENTATION PROCEDURES – MAINTAINING A FIELD LOGBOOK

SOP Number 03-01-06
Effective Date: 1/1/20

Technical Approval: ______________________________ Date: 1/1/2020

QA Management Approval: David E. Dobb ______________________________ Date: 1/1/2020

SOP Description

This Standard Operating Procedure (SOP) establishes general practices and requirements for the use of field logbooks during environmental field activities, including soil/sediment sampling, groundwater sampling, well installations, surface water sampling, environmental assessments, and environmental audits. SOPs for the use of field logbooks during Resource Conservation and Recovery Act (RCRA) Visual Site Inspections and oversight of RCRA Facility Investigations and Remedial Investigations are provided in SOP Nos. 03-03-XX and 03-04-XX, respectively.

Logbooks are used by personnel to document all activities and information gathered in the field. The field logbook entries must be legible, factual, detailed, and objective. Proper field documentation is crucial in the logbook because the logbook ultimately may become part of the public record and may be used in future legal actions. The field logbook must provide sufficient documentation to enable participants to reconstruct events that occurred and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures

12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Apparatus

- Field logbooks (one per sampling team, at a minimum)
- Black or blue pens with waterproof ink
- Compass (preferably)
- Watch

Type of Field Logbook

The field logbook must be bound and preferably waterproof. A standard surveyor's notebook or the "Rite in the Rain"® Weatherproof Transit Book No. 300, J.L. Darling Corporation, Tacoma, Washington, are types of acceptable notebooks that can be used by TechLaw Consultants, Inc. (TechLaw) personnel. Other notebooks are acceptable, provided that they are bound prior to use in the field. A supply of field notebooks should be kept in each office location.

Maintenance of Field Logbook

Each field team member may be required to maintain a field logbook; however, the Field Team Leader is responsible for the field logbooks. The Field Team Leader may designate a team member as the official record keeper. If feasible, each logbook is to be maintained by the same person for the duration of the project to ensure consistency in documentation. The Field Team Leader must review the logbooks during the environmental field activities to check that the procedures in this SOP are being followed and that the information is entered correctly. Additionally, it is the responsibility of the Field Team Leader to ensure that confidential business information (CBI) procedures are followed if confidentiality is requested by the facility representative.

Notations in Field Logbook

- All notations in field logbooks should be made in waterproof ink. A standard ball-point pen is acceptable.

- No erasures may be attempted. Any corrections or deletions are to be made by drawing a single line through the unwanted notation so that the notation is still legible. The writer then places their initials and the date near the deletion. Under no circumstances are pages to be removed from a field logbook.

- All field logbook notations must be legible.

- A separate field logbook must be used for each project/site. More than one logbook may be used for a single project if the complexity of the site requires that two or more separate field teams are active on different parts of the facility simultaneously. If more than one logbook is used for a project, each is to be numbered sequentially (e.g., 1 of 3, 2 of 3, 3 of 3). If two or more separate field teams are maintaining more than one logbook, each team's logbooks are to be numbered sequentially and clearly identifiable (e.g., Team A Book 1 of 2, Team A Book 2 of 2, Team B Book 2 of 2). Each page of the field logbook must be numbered. Each page also must be dated and signed by the writer. For pages only partially filled with text, a diagonal line or "Z" must be drawn from the end of the text to the bottom of the page. When field activities last more than one day, the next day's documentation begins on the next page of the field logbook. Relevant site information (e.g., weather, site personnel [personnel could change during the course of the field work], strategies) must be listed at the beginning of each day's activities. Also, more than one team member may maintain a logbook at the discretion of the Field Team Leader. Additional detail regarding maintenance of a field logbook is provided in the Series "03-" SOPs.

- The individual maintaining the logbook must put his/her name and contact information on the inside cover or the first (title) page of the logbook. The first page must include the title of the project, project number, facility name, facility location, U.S. Environmental Protection Agency (EPA) Identification Number (if appropriate), date(s) of activity, names and companies of other team members, and any other appropriate identifying information. If more than one field logbook is used at a facility, each must contain the required project information on the inside cover or the first (title) page of the logbook.

- Information is generally listed in chronological order in the field logbook and by the time of day. All times are to be entered in a 24-hour format (e.g., 7:00 p.m. is 1900). All factual information obtained during field activities must be recorded in the logbook. Information that is not in or referred to in the logbook may not be used in deliverables associated with the field work. The field logbook contains only factual information; no conclusions are recorded in the logbook. Weather conditions are documented at least twice a day and must be noted immediately with any significant weather change (e.g., thunderstorm).

Often, sketches are preferred to written descriptions (or used in conjunction with), especially where photographs will not be taken. Sketches must include a north arrow, a rough scale and position of buildings, and any other notable features and landmarks (e.g., trees, streets, etc.).

When photographs are taken, the photograph number is entered into the logbook, as well as time of day, compass direction, and a description of what was photographed. Relevant features, such as cracks and staining should be documented. See SOP No. 03-02-XX, Taking and Documenting Photographs, for further details.

- The field logbook is the property of the client.[1] The project manager is the custodian of the field logbook for the duration of the project. It must remain in the custody of the project manager (or a designated person) until the conclusion of the field portion of the project. The field logbook is then maintained in the central files.

- Once a field logbook is filled, the logbook should be scanned and a copy placed in the central files (electronic or hard copy) as soon as possible. Additionally, it is recommended that copies of previous logbooks, instead of original logbooks, are brought into the field to minimize the risk of losing hard copy logbooks.

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress, which is consistent with Occupational Safety and Health Administration (OSHA) and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed shoes, safety glasses, and chemical-resistant gloves.

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[1] Work products, such as field logbooks, that are generated during the performance of government contracts are considered the property of the government client. See SOP No. 11-06-XX for further details regarding document control requirements.

A site-specific health and safety plan (HASP) must be developed by the Field Team Leader or designee and approved by the TechLaw Health and Safety Director prior to implementation in the field. This plan must be reviewed by all field team members prior to beginning work.

Any deviation(s) from an approved site-specific HASP must be documented in the field logbook.

Quality Assurance/Quality Control (QA/QC)

The Field Team Leader or designee is to conduct periodic QC reviews during a site visit to ensure documentation procedures and administrative requirements have been met.

Comments/Notes

None at this time.

Attachments

None at this time.

References

TechLaw Consultants, Inc., Corporate Quality Management Plan, current version.

TechLaw Consultants, Inc., Health and Safety Program Plan, current version.

TechLaw Consultants, Inc., Security Plan for the Control of Confidential Business Information, current version.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14, Washington, D.C., December 1987.

U.S. Environmental Protection Agency, Office of Solid Waste, RCRA Facility Assessment Guidance, October 1986.

RECORD OF CHANGES/REVIEW		
Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
03-01-05	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
03-01-06	1/1/2020	Entire document reviewed and updated. Changed company name to TechLaw Consultants, Inc.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

FIELD DOCUMENTATION PROCEDURES -
TAKING AND DOCUMENTING PHOTOGRAPHS

Page 1 of 8
SOP Number: 03-02-07
Effective Date: 1/1/20

Technical Approval: Mani Luan ________________________ Date: 3/27/2020

QA Management Approval: ________ David E. Dobb ________ Date: 3/27/2020

SOP Description

This Standard Operating Procedure (SOP) establishes the practice and requirements for documenting and taking photographs during field activities, including: RCRA Visual Site Inspections (VSIs), oversight of RCRA Facility Investigations (RFIs), oversight of Remedial Investigation/Feasibility Studies (RI/FSs), oversight of remedial design/remedial actions (RD/RAs) and removal actions, compliance enforcement inspections (CEIs), comprehensive groundwater monitoring evaluations (CMEs), conduct of sampling activities, and property transfers.

The purpose of these activities is to gather sufficient information and documentation to relay observations to the client and to provide the basis for suggestions for further action or recommendations.

Photographs are taken to obtain visual information concerning unit characteristics, waste characteristics, pollutant migration pathways, releases, and exposure potential. Critical documentation is important because these photographs may eventually be used in enforcement/defense cases, legal actions (as evidence of past releases), or as a basis for property transactions. The photographs could be used months or years later, and must be thoroughly documented.

This SOP indicates the type of information that must be recorded in the field logbook in conjunction with the type of items that must be photographed. The photograph log serves as a visual record of what was seen during the field activities.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures
08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI – Specific SOPs

Equipment and Apparatus

- Digital camera (If it is a large facility, two cameras may be necessary.)
- Cell phone camera (when the contract and facility allows)
- Extra batteries
- Charger for rechargeable batteries
- Compass (preferably)
- Watch
- Ruler/pen/coin (to illustrate scale)

Permission to Take Photographs

When conducting field activities, obtain permission to take photographs from the facility representative prior to the field activities. If there is an appearance of resistance from the facility representative, inform the client and together develop a course of action/strategy to obtain resolution prior to the field activities. In addition, it is the responsibility of the Field Team

Leader to ensure that confidential business information (CBI) procedures are followed if confidentiality is requested by the facility representative.

Maintenance of the Camera

The following generic operating and maintenance activities must be performed in accordance with specific directions provided with the camera.

- Routine inspection and cleaning are to be conducted prior to the field activities. If unfamiliar with the type of camera, review the general directions provided by the manufacturer. However, prior to field activities, ensure familiarity with such “how to” procedures as:
    - Insert and check the battery
    - Charge the battery, if applicable
    - Clear memory card, if applicable
    - Set the clock
- Routine testing of batteries must be conducted prior to the field activities and at the beginning of each day in the field. Rechargeable batteries should be charged daily. Additional spare camera batteries should be on hand.
- Remedial action in the event of failure or malfunction must be in accordance with the camera warranty (if applicable) and directions for troubleshooting. A malfunction can be caused by shock, humidity, salt, etc. If a camera has been used in the presence of chemicals, it is to be wiped clean.

General Information Regarding Cameras and Film

Camera Types

Each TechLaw Consultants field-ready office location should have a digital automatic-focusing camera or access to one. See SOP No. 02-07-XX for details regarding equipment acquisition, inventory and maintenance if more than one camera is needed. These cameras are relatively simple to use since they do not require manual focusing or shutter speed adjusting. This is advantageous since the photographer may also be tasked with recording the photograph description and picture number, as well as asking questions regarding the purpose of the unit being photographed. These cameras should have an internal clock which records the date and/or time the photograph was taken. Setting the clock is important because it provides additional documentation and also helps in organizing the photographs. The date is a priority. If you can include both settings (i.e., date and time), this is preferred. While cell phone cameras record the date and time photographs are taken, they might not allow photographs to be labeled the same way digital cameras do. If labels are necessary, a digital camera will have to be used.

Quantity of Memory Needed

If a digital camera is used, the camera's memory card should allow for a sufficient number of photographs. Before commencing field activities, it should be ensured that the memory will meet the project needs using the guidelines for film cameras in the section above. If camera memory becomes an issue on site, lower resolution settings can be used.

Treatment and Shipment of Camera

There are no special shipment procedures for the camera. The camera can be packed and checked in the suitcase of the field personnel or shipped in an ice chest with other field equipment. In order to prevent loss, it is recommended that the camera's memory card be carried onto the plane and kept in one's possession at all times.

Types and Subjects of Photographs

- During field activities, the Field Team Leader selects one team member to take photographs and record the appropriate information in the field logbook. Photographs must be taken of each unit or SWMU identified unless the facility representative denies permission for that particular unit. In these cases, the refusal is to be documented in the field logbook.

- Photographs are taken to document conditions at the facility or sampling activities. The types of pictures taken must include:

    - Representative overall pictures of the facility or site;
    - Posted signs identifying ownership of the facility or site;

  - Evidence of releases (e.g., leachate seeps, pools of liquid, discolored water, and stained soils);
  - Individual units such as lagoons, drums, and landfills;
  - Visual evidence of poor facility maintenance;
  - Examples of typical facility operation;
  - Adjacent land use;
  - Sample locations/activities; and
  - Areas that unauthorized persons can easily access.

- Information that must be recorded in the field logbook in conjunction with each photograph includes:

  - Photographer's name;
  - Photograph number;
  - Date and time;
  - Name and identification number of unit or SWMU;
  - Location of unit or SWMU;
  - Orientation of photograph (i.e., direction photographer is facing);
  - Observed evidence of release (e.g., staining, overflow);
  - Notable features of unit or SWMU that may provide evidence of release (e.g., cracking, obvious lack of integrity of unit);
  - Information to help characterize the unit, or picture; and
  - Other comments (e.g., weather, if a zoom lens was used, etc.).

- When photographs are taken of objects that are small or close up, it is often helpful to use a ruler, pen or coin in the frame to illustrate the scale so one will be able to more easily explain or describe the dimensions or proportions.

- During sampling activities, photographs are to be taken of actual sample collections, conditions of sampling location (e.g., monitoring well head and pad, soil sampling location with respect to surroundings), filled sample containers, and the chain-of-custody seals on the closed and sealed ice chests.

- For engagements conducted for regulatory agencies or in the case of property transactions, permission to take photographs must be obtained from the owner/operator of the facility. Inform the owner/operator that you will point out or explain what you would like to photograph before you actually take the photographs.

Listed below are three possible scenarios, in order of preference, by which photographs are taken and processed:

- You take the photographs using the TechLaw Consultants camera and leave with the photograph files.
- If permission for you to take the photographs is denied, negotiate with the owner/operator to have them take the photographs using the TechLaw Consultants camera.
- The least desirable approach is when permission to take the photographs is denied, or the facility allows you to take the photographs but will not let you leave with the memory card. In these cases, negotiate with the owner/operator to have the photographs processed, review them, and provide the required number of copies to you. In these cases, the client (e.g., EPA) must be aware of these arrangements and approve them. Note: There have been instances where photographs were taken by the owner/operator but were never provided to TechLaw Consultants.

Processing/Handling of Photographs and Compact Discs

If physical copies are required, commercial developing facilities may be utilized for processing digital photographs. A minimum of two 4x6 copies of each photograph must be requested – one for submittal to the client and the other for the TechLaw Consultants files. Prior to processing, determine how many copies of the photographs are needed through discussions with the client or Project Manager. For example, some clients require two copies; therefore, in order to have a set for the TechLaw Consultants files, three copies must be made. On occasion, the facility will request a copy of the photographs. If the client is a regulatory agency (e.g., EPA), this must be approved by the regulator prior to providing the photographs to the facility. Financial reimbursement must be agreed to prior to photographic duplication. At the end of the assignment, the compact discs (CDs) are forwarded to the Program Manager or designee for inclusion in the central files.

In instances where a facility requests that the photographs be treated as CBI (or some other form of confidentiality), the photographs must be designated, logged, handled, stored, and transmitted in the same manner as any other CBI material.

Photo Log

The purpose of a photo log is to present the photographs taken during field activities along with brief documentation describing them. Each write-up is to provide the name and number of the unit (e.g., Storage Tank 11, SWMU 3), a description of the unit or activity, and the compass direction. Note any particular background items that should be brought to the attention of the reader (e.g., note the absorbent materials on the floor around the drum). Notations should be limited to pertinent facts. The photo log format may vary depending upon the client's instructions. Two examples are provided in Attachment A.

In addition, maps and drawings (which contain a scale and compass points) can be appended to provide further clarification of the photographs and field logbook entries. Notations can be made on the maps showing where the photographs were taken and in what compass direction, as well as the photo number on the CD (if applicable).

If any post processing (e.g., cropping or zooming) is done to digital photographs, this must be noted in the photo log. The original print, as well as the post-processed print should be provided to the client. Also, if post-processing is conducted, both the original photograph and the post-processed version must be placed on a CD-ROM or DVD-ROM in TechLaw Consultants' central files.

Health and Safety

It is TechLaw Consultants' policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with OSHA and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include safety-toed shoes, safety glasses, and chemical-resistant gloves.

A site-specific health and safety plan must be developed by the Field Team Leader or designee and approved by the TechLaw Consultants Health and Safety Director prior to implementation in the field. This plan must be reviewed prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

QA/QC

None at this time.

Comments/Notes

Upon project completion, the logbook(s), one set of photographs and all CDs must be forwarded to the central files.[1]

Attachments

Attachment A – Photograph Log Example

References

TechLaw Consultants, Inc., Corporate Quality Management Plan, most current revision.

TechLaw Consultants, Inc., Health and Safety Program Plan, most current version.

TechLaw Consultants, Inc., Security Plan for the Control of Confidential Business Information, most current version.

U.S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. Washington, D.C., 1987.

U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Characterization of Hazardous Waste Sites - A Methods Manual, Volume 1 - Site Investigations, EPA/600/4-84/075, Las Vegas, NV.

U.S. Environmental Protection Agency, Office of Solid Waste, RCRA Facility Assessment Guidance, October 1986.

U.S. Environmental Protection Agency, Region IV, Environmental Service Division, Engineering Support Branch Standard Operating Policies and Procedures, Georgia, February 1991.

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[1] Work products such as photographs that are generated during the performance of government contracts are considered the property of the client. See SOP No. 11-06-XX for further details regarding document control requirements.

ATTACHMENT A [Revised 1/1/20]
SOP Number: 03-02-07

PHOTOGRAPH LOG EXAMPLE

1. Overview of finished monitoring well LF-2, facing southwest. Note drums containing drill cuttings are in contact with the soil.

2. Facing northeast towards finished monitoring well LF-2. Note the well casing has not been grouted around the surface. The drums contain drill cuttings.

3. View (looking east) of the Torit Dust Collector. Note the 55-gallon drums which receive the particulates that are removed from the indoor air. This is a representative unit for the other cyclones in the plant.

4. Close-up view of the Former Oil/Water Separator No. 13. This unit is presently operating as a catch basin for oily wastewater prior to piping to the Building 29-N 40,000-Gallon Oily Wastewater Tank (SWMU A-5).

5. View (looking east) of the removal pipe for Tank W-82. The Waste Oil Vacuum Truck (SWMU L-46) collects the waste oil/jet fuel at this point. Note the staining on and poor condition of the asphalt. The stained building in the background is a test cell.

6. View of Underground Waste Storage Tanks W-89 and W-92 after being exhumed. The hole was cut in the side of the tank to examine the metal for value as scrap. This is not the original location of these tanks.

7. View of surface access area to Underground Waste Oil Storage Tank W-50. Note the oil-stained pavement and absorbent in the area.

8. View (looking north) of the manhole and bermed access area to underground Waste Storage Tank W-53. Note oil staining on berm and in containment area.

9. View of rinsing split spoon sampler, in foreground, with the drill rig in the background. Note the driller in the background is not wearing gloves.

10. Underground Discharge Pipe. Close-up of the asphalt road covering the underground discharge pipe. The location of the pipe is indicated by the parallel cracking. Note: In the background are the former lagoons. View is facing west.

ATTACHMENT A [Revised 1/1/20]
SOP Number: 03-02-07

Example

TECHLAW CONSULTANTS

Contract No. 8XXXX-Contract Title

[Insert Photo Here]

PHOTO #

SITE NAME\EPA ID # ____

SITE LOCATION ____

PHOTOGRAPHER/WITNESS____

DATE _________ **TIME** _____________ **DIRECTION** _________________ **TO#** ________________

COMMENTS____
____
____
____
____

A second procedure for photograph logs is by using Avery Labels #5163 (or similar) for printed photographs. The completed photograph log labels are peeled and placed on the back of the appropriate photograph. The photographs are then placed into a clear plastic photograph storage sheet. See below for an example of the photograph log labels format:

Photo #T1-01 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1325

Tank 901A, labeled "Used Alkaline Storage".

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SE

Photo #T1-02 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1405

Tank 901A. Note: dark material in secondary container. Location for Sample SUI01.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SW

Photo #T1-03 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1410

Drum located next to Tank 901A (just north). Note: no label is observed on the drum. Sample SUI05 collected from this drum.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SE

Photo #T1-04 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1440

Photo of sample jar of sample SUI05. Note: The sample jar is an amber color and does not reflect the color of the material inside.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SE

Photo #T1-05 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1445

Photo of sample jar for sample SUI01. Note: The sample jar is an amber color and does not reflect the color of the material inside.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SE

Photo #T1-06 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1513

Photo of "Used Cyanide Storage" Tank 901B. This is the sample location of Samples SUI02 and SUI03.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SW

Photo #T1-07 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1515

Photo of Acid Tank. Sampling location for sample SUI04.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** NE

Photo #T1-08 **City:** Tulsa, OK
Site: Name Industries, Inc. **Time:** 1540

Photo of southern portion of the Covered Hazardous Waste Storage Area.

Photo By: Photographers Name **Date:** 2/24/07
Witness: Witness Name **Direction:** SE

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
03-02-06	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
03-03-07	1/1/2020	Reviewed, removed references to film cameras, added cell phone cameras when allowed, minor changes throughout, changed company name to TechLaw Consultants, Inc.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURE

PACKAGING AND SHIPPING PROCEDURES – ENVIRONMENTAL SAMPLES

Page 1 of 10
SOP Number: 04-02-06
Effective Date: 1/20/2021

Technical Approval: Erika Erikson Date: 1/20/2021

QA Management Approval: Date: 1/20/2021

SOP Description

This Standard Operating Procedure (SOP) describes TechLaw Consultants, Inc.'s (TechLaw's) procedures for the packaging and shipping of environmental samples.

It is the Field Team Leader's responsibility to determine whether the samples meet the definition of environmental or dangerous goods samples and to follow the appropriate packaging and shipping procedures, SOPs, and related guidance. Assistance in determining sample categories can be obtained from senior TechLaw staff/managers.

General Procedures

Environmental samples of solid waste, soil, air or water collected for the sole purpose of testing to determine its characteristics or composition are excluded from the requirements of 40 CFR 261-270 when the sample is being transported to a laboratory for purpose of testing and the shipper complies with U.S. Department of Transportation (DOT), International Air Transportation Association (IATA), or other applicable shipping requirements.

The appropriate shipping procedures for environmental samples are detailed in this SOP.

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Standard Operating Procedures
02	General Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures

08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Containing Materials Procedures
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI - Specific SOPs

Related Documentation

The following documents should be used in conjunction with this SOP regarding the packaging and shipment of environmental samples.

- Field Logbook
- Site Sampling and Analysis Plan (SAP)
- Health and Safety Plan (HASP)
- Other relevant facility/site information

Definitions:

- **Dangerous Good –** an article or substance, which is capable of posing a significant risk to health, safety, or property when transported by air and which meets the criteria of one or more of nine United Nations (UN) hazard classes and, where applicable, to one of three UN packing groups. The nine classes are related to the *type of hazard* whereas the packing groups are related to the *degree of danger* within the class. The nine hazard classes are as follows (see the DOT and/or IATA Dangerous Goods Regulations for a complete description, subdivisions, and chemical properties of each hazard class):

  Class 1 – Explosives
  Class 2 – Gases
  Class 3 – Flammable Liquids

Class 4 – Flammable Solids; Substances Liable to Spontaneous Combustion; Substances Which, in Contact with Water, Emit Flammable Gases
Class 5 – Oxidizing Substances and Organic Peroxides
Class 6 – Toxic and Infectious Substances
Class 7 – Radioactive Material
Class 8 – Corrosives
Class 9 – Miscellaneous Dangerous Substances and Articles, including Environmentally Hazardous Substances

Dangerous goods are assigned to the relevant packaging group according to the degree of the danger they present:

Packaging Group I – high danger
Packaging Group II – medium danger
Packaging Group III – low danger

- **Environmental Samples –** normally include drinking water, most groundwater and ambient surface water, soil, sediment, and any samples not containing high levels of hazardous materials or hazardous waste. These types of samples generally are not considered a hazardous waste in 40 CFR 261.3, or hazardous materials under the regulations in 49 CFR 171 through 178. These samples are collected from areas where high concentrations of constituents are not likely to be found.

- **Hazardous Material** – a substance or material, 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. The term includes hazardous substances (40 CFR 302.4), hazardous waste (40 CFR 261), marine pollutants (49 CFR 172.101, Appendix B), and elevated temperature materials (49 CFR 171.8).

Every effort should be made to determine the category of the sample (environmental or dangerous goods) prior to collection of samples. Use available file information about the site or areas to be sampled. Review any existing analytical data from previous samples collected at the site. Review waste generation data, including where wastes have been disposed on site and any waste characteristic information provided by the facility or other sources (e.g., EPA or State agency).

Sample Category Determination:

Only personnel with DOT or IATA Training, including function specific training, will collect samples and determine the category of the sample.

When making a determination whether samples can be shipped as <u>environmental</u> samples, ask the following questions:

1. Does the sample pose an unreasonable risk to health, safety or property when transported in commerce (e.g., is it shock sensitive, does it emit toxic or noxious gases)? Could its contents become unstable/more volatile in an unpressurized cargo air craft?

2. Does the sample meet the criteria of one or more of the 9 UN hazard classes discussed above?

3. Is the contaminant(s) of concern in the sample material collected on the list of hazardous material in 49 CFR 172.101 Hazardous Materials Table or the IATA List of Dangerous Goods (IATA Regulations)?

4. If samples are collected from a drum, tank, impoundment, or other type of area (source) where hazardous waste/materials are known to be or highly suspected to have been disposed, these samples may **<u>NOT</u>** qualify as environmental samples and may require field testing/screening and/or further investigation. **STOP** and proceed to SOP No. 04-03-XX.

If any of these cases are true, samples <u>must</u> be shipped as Dangerous Goods by personnel with specific training in DOT and/or IATA shipping requirements. Refer to SOP 04-03-XX for Dangerous Goods Shipping Procedures.

Otherwise, proceed with shipping the environmental samples according to the following procedures.

<u>Procedures for Packaging and Shipping Environmental Samples</u>

The procedures for packaging and shipping environmental samples are split into four sections: pre-field preparation of the coolers; preparation of sample containers for shipment; preparation of coolers for shipment; and preparation of the shipping documentation.

Prior to any field activities requiring shipments of samples via FedEx or other transportation service (e.g., UPS), contact the shipping company and determine the following: any transporter specific requirements; the nearest location of the transporter's drop-off office to the field activities; and operating hours of the nearest office.

Pre-field Cooler Preparation

(1) Ensure that a sufficient number of coolers have been acquired to allow all samples to be shipped. Use clean, insulated coolers and remove all tape, markings, labels, and custody seals remaining on the outside of the coolers. If possible, the coolers should be washed inside and out prior to use.

(2) Secure and tape the drain plug on the outside of the cooler with fiber or duct tape to prevent leakage from the plug should a sample container or ice bag leak inside the cooler.

(3) Fill several large (quart or gallon size) plastic bags (e.g., zip-lock bags) with ice and place each bag of ice within a second zip-lock bag. Place the zip-lock side of the ice filled bag, down into the second bag. Ice bags are double-bagged to prevent water leakage when the ice melts during sampling. The ice will be used to start cooling the samples as they are collected.

Sample Container Preparation

Once samples have been collected, the following steps should be taken in preparing samples for shipment.

(4) Groundwater, surface water and soil environmental samples may require preservation prior to shipment to the laboratory. Refer to SOPs Series Nos. 06-XX-XX, 07-XX-XX and 08-XX-XX for sample preservation techniques, as well as the project-specific Quality Assurance Project Plan (QAPP) requirements.

(5) Label all samples according to the procedures outlined in SOP No. 02-04-XX. Either sample container labels or sample tags may be used.

(6) Wrap each glass bottle with bubble wrap or use bubble wrap bags. Measure out a piece of bubble wrap large enough to surround the entire bottle. The bubble wrap helps protect the sample containers from breakage during transport. Use tape to secure the bubble wrap around the bottle. There is no need to wrap plastic sample containers with bubble wrap.

For VOA sample containers (40 ml vials), spread out a sheet of bubble wrap one or two sheets long. Two to three vials (i.e., one sample) will be wrapped together using the prepared sheet. Place a vial on the top corner, horizontally, on the width end of the bubble wrap. Starting from the vial end, roll the bottles into the remaining bubble wrap. When complete, bend the long roll into a V, and tape the package.

(7) Place each sample container (with the exception of very large containers, e.g., one-gallon amber jars) inside a resealable zip-lock-type plastic bag (two resealable zip-lock-type bags may be utilized for the one-gallon amber jars). Custody seal tape may be placed around the bag if additional security is desired. For large containers, if a large zip-lock-type bag is not available, wrap the bottle in bubble wrap and place the container in a clean, unused garbage bag. Tape the opening of the bag closed.

Cooler Preparation

(8) Place each labeled, wrapped and bagged sample container in the cooler in an upright position. Cardboard separators may also be placed between the sample jars at the discretion of the shipper.

As a guide, the approximate number of bottles that fit in a 45-quart cooler are:

Liquid	
1 L Amber	Up to 8
1 L Poly	Up to 15
500 ml Poly	Up to 15
40 ml Vials	Up to 75
Soil	
8 oz glass	Up to 17
4 oz glass	Up to 25

(9) Check each ice bag used to cool the samples during sampling activities. If the ice has melted a notable amount, either: discard and fill a new large (quart or gallon size) plastic bag (e.g., zip-lock bag) with ice and place the bag of ice within a second zip-lock bag with the zip-lock side of the ice filled bag, down into the

second bag; or, open both zip-lock bags, drain the water, replenish the ice, and double bag as described previously. Ice bags are double-bagged to prevent water leakage when the ice melts during transit. Dry ice should not be used to cool the samples since it is a regulated dangerous good. If dry ice is required for shipment (as in the case of biological tissue sample shipment), contact the Regional Dangerous Goods Shipper.

Place the ice bags around the sample containers inside the large outer plastic bags to keep the samples cool during shipment. Fill the remainder of the cooler with bubble wrap or other appropriate packing material. Remember to place a temperature blank into the cooler prior to sealing and shipping (see project specific Quality Assurance Project Plant [QAPP] for applicability).

(10) Complete the chain-of-custody form and place it along with the necessary sample documentation forms (i.e., chain-of-custody, Contract Laboratory Program Traffic reports, etc.) inside a zip-lock plastic bag. The procedures for completing the chain-of-custody paperwork are discussed in SOP No. 02-05-XX. Tape the plastic bag containing the paperwork to the underside of the cooler lid. Close the cooler lid and tape the cooler latch shut to prevent accidental opening during shipment.

(11) Wrap each end of the outside of the cooler with strapping tape such that it cannot be opened during shipment. Normally, the tape is wound around the outside of the cooler for a total of three (3) turns, at both ends of the cooler. Up to two custody seals should be affixed to each side of the cooler across the lid opening so that the cooler cannot be opened without breaking the seals. To prevent the accidental tearing of the seal during shipment, it is advisable to place clear packaging tape over the seal. This ensures that the custody seal is firmly affixed to the cooler, yet it can be seen through the thin layer of tape.

Shipping Paperwork Preparation

(12) If shipping by air, obtain a standard FedEx or UPS airbill. If shipping samples for a government client, use a TechLaw Government FedEx or UPS account number.

(13) Attach a label marked as “FROM:” containing the name and address of the shipper and “TO:” containing the name, address and contact person of the recipient of the cooler to the outside of the cooler lid. Separate labels for “TO” and “FROM” may also be used. These labels are attached to the cooler as added security in case the shipper label becomes separated from the cooler. See Attachment C for a visual example.

(14) Complete the shipper’s airbill with the appropriate information. Be sure to include a TechLaw job number in the box labeled for “Internal Billing Reference Information.” See Attachments A and B for examples of FedEx and UPS airbills. Fill in the weight of the package, if you have it. If not, the transporter will complete the information related to the weight of the package. Note that the transporter may use dimensional weight as an estimate, which is usually higher (and more expensive) than actual weight. Once completed, affix a TechLaw airbill or plastic airbill pouch to the outside of the cooler lid. The transporter may have airbills that affix to cooler handles and these may be used in place of other airbills. If an airbill pouch is used, slip the completed airbill into the pouch. Do not seal the pouch. Make sure you pull the top copy of the airbill before relinquishing the cooler to the transporter. The copy of the airbill should then be placed into the project files.

Health and Safety

It is TechLaw’s policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with EPA, DOE, and OSHA established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include steel-toed shoes, safety glasses, and chemical-resistant gloves.

Refer to a site-specific HASP for detailed health and safety procedures. This plan should be reviewed prior to beginning any work.

Sample Processing and Storage

Processing – processing includes labeling, double bagging, affixing seals, etc. Due to the potential for the outside of sample containers to be contaminated, samples are to be processed in dedicated areas only. Desks and conference tables are not to be used unless that is the sole use for the area (i.e. don’t process samples on the same surface you put your lunch). If an office does not have a designated area, samples will be processed outside of the building.

Storage – many samples require refrigeration. Under no circumstances are samples to be stored in a refrigerator unless it is clearly labeled “For Samples Only, No Food Allowed” or words to that effect. Removal of such labels is prohibited without first decontaminating the refrigerator and obtaining concurrence from the TechLaw Health and Safety Director. Samples may be stored in dedicated coolers with sufficient ice to maintain the required temperature.

QA/QC Section

Prior to sealing coolers, the Field Team Leader should check all paperwork, address labels and shipping documents for accuracy.

Any deviations in preservation techniques should also be documented in the field logbook and justified. Deviations are to be sufficiently documented to allow repetition of the activity as actually performed.

Comments/Notes

Prior to commencing field activities, ensure that appropriate equipment is readied for the activities. In addition, obtain the location, phone number and office hours of the transporter’s office nearest to the field activity site.

Attachments

Attachment A – Sample FedEx Airbill
Attachment B – Sample UPS Airbill
Attachment C – Diagram of Labeled Cooler

References

International Air Transport Association (IATA), Dangerous Goods Regulations, Effective from 1/1 to 12/31 of each year.

TechLaw Consultants, Corporate Quality Management Plan, current version.

TechLaw Consultants, Health and Safety Program Plan, current version.

U.S. Environmental Protection Agency, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), U.S. EPA Region IV, November 2001.

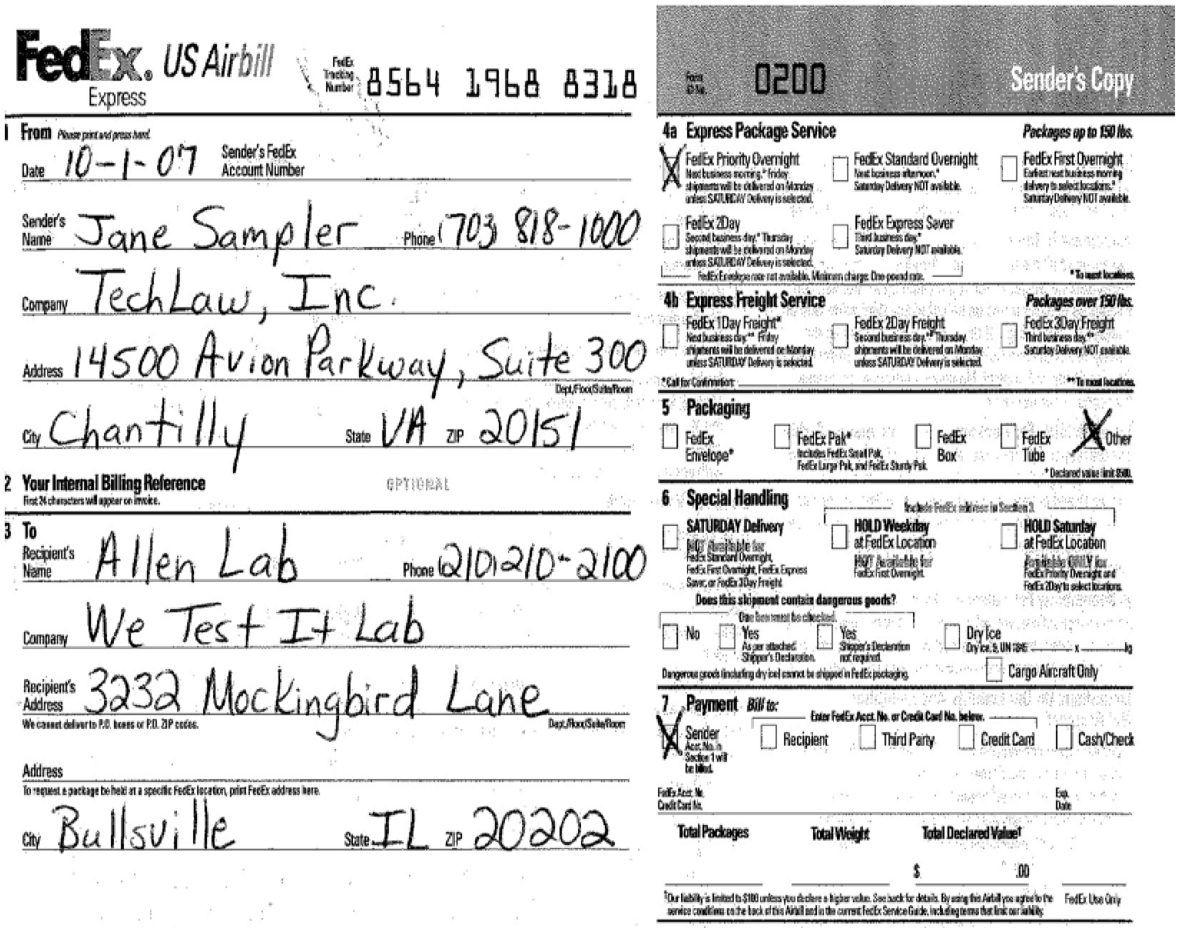
U.S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, Washington, D.C., 1987.

U.S. Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, EPA/600/4-84/075, April 1985.

U.S. Environmental Protection Agency, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OWSER-9950.1, September 1986.

ATTACHMENT A [Revised 1/20/2021]
SOP Number: 04-02-06

SAMPLE FEDEX AIRBILL



FedEx. US Airbill Express

FedEx Tracking Number 8564 1968 8318

Form ID No. 0200

Sender's Copy

1 From Please print and press hard.

Date 10-1-07 Sender's FedEx Account Number

Sender's Name Jane Sampler Phone (703) 818-1000

Company TechLaw, Inc.

Address 14500 Avion Parkway, Suite 300 Dept./Floor/Suite/Room

City Chantilly State VA ZIP 20151

2 Your Internal Billing Reference
First 24 characters will appear on invoice.
OPTIONAL

3 To

Recipient's Name Allen Lab Phone (210) 210-2100

Company We Test It Lab

Recipient's Address 3232 Mockingbird Lane Dept./Floor/Suite/Room
We cannot deliver to P.O. boxes or P.O. ZIP codes.

Address
To request a package be held at a specific FedEx location, print FedEx address here.

City Bullsville State IL ZIP 20202

4a Express Package Service *Packages up to 150 lbs.*

☒ FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
☐ FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.
☐ FedEx First Overnight — Earliest next business morning delivery to select locations.* Saturday Delivery NOT available.
☐ FedEx 2Day — Second business day.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
☐ FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

FedEx Envelope rate not available. Minimum charge: One-pound rate.
*To most locations.

4b Express Freight Service *Packages over 150 lbs.*

☐ FedEx 1Day Freight* — Next business day.** Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
☐ FedEx 2Day Freight — Second business day.** Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
☐ FedEx 3Day Freight — Third business day.** Saturday Delivery NOT available.

*Call for Confirmation:
**To most locations.

5 Packaging

☐ FedEx Envelope*
☐ FedEx Pak* — Includes FedEx Small Pak, FedEx Large Pak, and FedEx Sturdy Pak.
☐ FedEx Box
☐ FedEx Tube
☒ Other

*Declared value limit $500.

6 Special Handling

Include FedEx address in Section 3.

☐ SATURDAY Delivery — NOT Available for FedEx Standard Overnight, FedEx First Overnight, FedEx Express Saver, or FedEx 3Day Freight.
☐ HOLD Weekday at FedEx Location — NOT Available for FedEx First Overnight.
☐ HOLD Saturday at FedEx Location — Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Does this shipment contain dangerous goods?
One box must be checked.

☐ No
☐ Yes — As per attached Shipper's Declaration.
☐ Yes — Shipper's Declaration not required.
☐ Dry Ice — Dry Ice, 9, UN 1845 ______ x ______ kg
☐ Cargo Aircraft Only

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging.

7 Payment *Bill to:*

Enter FedEx Acct. No. or Credit Card No. below.

☒ Sender — Acct. No. in Section 1 will be billed.
☐ Recipient
☐ Third Party
☐ Credit Card
☐ Cash/Check

FedEx Acct. No.
Credit Card No.
Exp. Date

Total Packages	Total Weight	Total Declared Value†
		$ .00

†Our liability is limited to $100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

FedEx Use Only

ATTACHMENT B [Revised 1/20/2021]
SOP Number: 04-02-06

SAMPLE UPS AIRBILL

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to UPS)

Shipper: Pat Package
ABC Company
WELLESLEY ISLAND, NY 13640, United States (US)

Air Waybill No.
Page 1 of 1 Pages
Shipper's Reference Number
(optional)

Consignee: Bill Box
XYZ Corporation
1234 High St
United Kingdom (GB)

Two completed and signed copies of this Declaration must be handed to the operator

TRANSPORT DETAILS
This shipment is within the limitations prescribed for:
(delete non-applicable)
PASSENGER AND CARGO AIRCRAFT | ~~XXXXX~~
Airport of Departure
Airport of Destination

WARNING
Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

Shipment type: (delete non-applicable)
Non-Radioactive | ~~XXXXXXXXX~~

NATURE AND QUANTITY OF DANGEROUS GOODS
Proper Shipping Name, Class or Division, UN Number or Identification Number, Packing Group (if required), number of packages, and all other required information

Additional Handling Information
24-hour Number 1-800-555-1234

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
Pat Package / Shipping Manager
Place and Date
New York 10-10-2007
Signature
(see warning above) Pat Package

ATTACHMENT B [Revised 1/20/2021]
SOP Number: 04-02-06

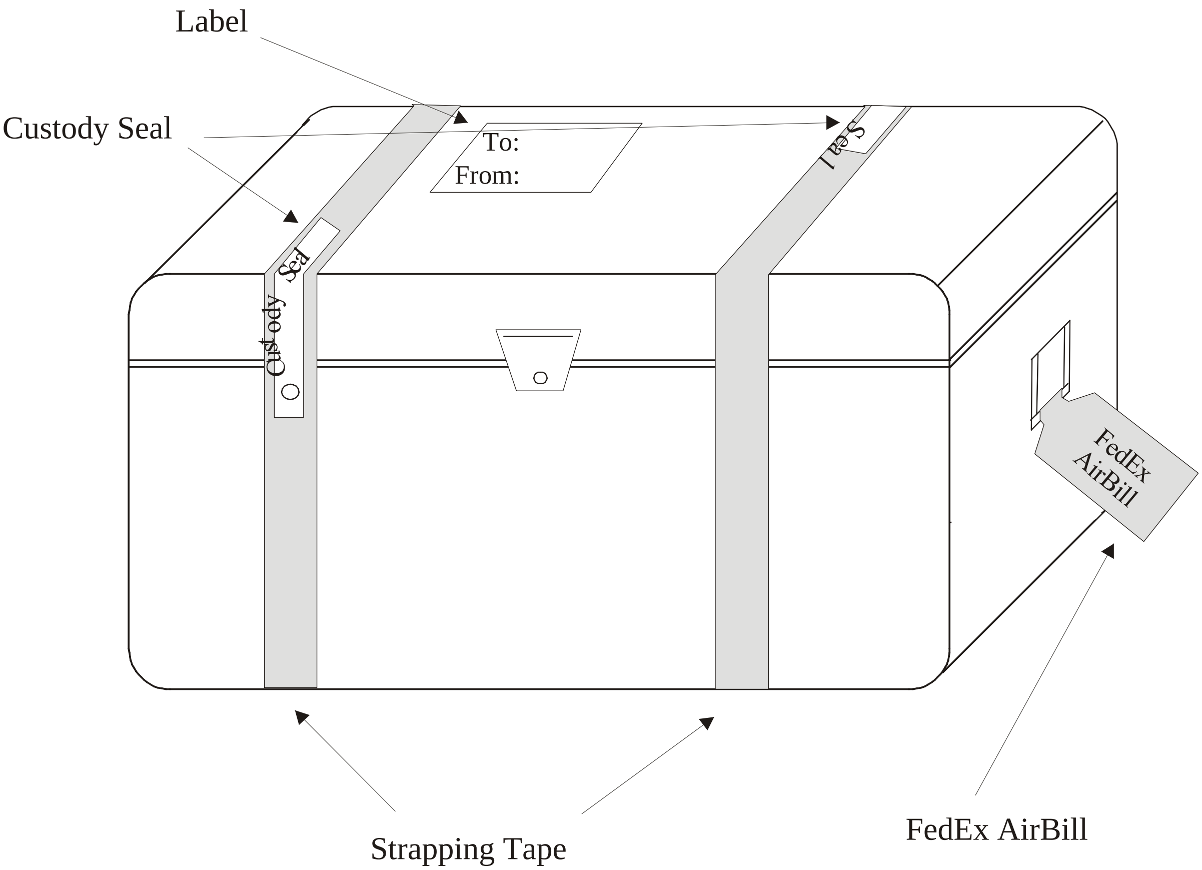
Instructions for UPS

- **Consignee:** Enter the full name and address of the consignee.
- **Air Waybill Number:** For air cargo shipments, the air waybill number is entered in this field. For small package shipments, the tracking number is entered.
- **Page X of X Pages:** Enter the page number of the shipper’s declaration. If there is only one page for the shipment, note that the shipper’s declaration is "Page 1 of 1 Pages".
- **Aircraft Limitation:** Delete the type of aircraft that does not apply.
- **Airport of Departure:** Leave blank.
- **Airport of Destination:** Leave blank.
- **Shipment Type (Radioactive/non-Radioactive):** Delete the shipment type that does not apply.
- **Nature and Quantity of Dangerous Goods.**
  - **UN or ID Number:** Enter the UN or ID number for the material.
  - **Proper Shipping Name:** Enter the proper shipping name. (with Technical Name when required)
  - **Class or Division:** Enter the hazard class or division for the material.
  - **Subsidiary Risk:** Enter the subsidiary risk, if applicable. This subsidiary risk must be enclosed in parentheses.
  - **Packing Group:** Enter the Packing Group assigned, if applicable.
  - **Quantity and Type of Packing:** A description of the package and an indication of the quantity of material being shipped (use net quantity unless the regulations require gross mass; metric measure is mandatory)
  - **Packing Instructions:** The IATA Packing Instruction number must be noted in this column.
  - **Authorization:** Location for any Special Provision numbers, DOT special permits, LAA approval numbers, EX numbers or other pertinent authorization information.
- **Additional Handling Information:** The shipper uses this box to indicate the appropriate 24-hour emergency response telephone number (in conjunction with the ER Registrant information) or any special handling information relevant to the shipment.
- **Certification:** By completing this section, the shipper certifies that the package is in compliance with all rules and regulations.

  The shipper is responsible for ensuring that all copies of the shipper's declaration are clear and legible.
  If you have any questions about shipping hazardous materials with UPS, please call the UPS Hazardous Materials Support Center at 1-800-554-9964.

ATTACHMENT C [Revised 1/20/2021]
SOP Number: 04-02-06

SAMPLE COOLER



RECORD OF CHANGES/REVIEW

Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
04-02-03	04/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
04-02-04	12/03/2018	Editorial changes/clarifications.
04-02-05	08/01/2019	Added sample processing and storage warnings to Health & Safety section
04-02-05	1/1/2020	Changed Company Name to TechLaw Consultants, Inc.
04-02-06	1/20/2021	Minor editorial revisions

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

SOIL/SEDIMENT SAMPLING AND ANALYSIS PROCEDURES – SURFACE/NEAR SURFACE SOIL SAMPLING

Page 1 of 7
SOP Number 07-03-05
Effective Date: 1/1/20

Technical Approval: ______________________________ Date: 1/1/2020

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SOP Description

This Standard Operating Procedure (SOP) describes the techniques and requirements for collection of surface/near surface soil samples by TechLaw Consultants, Inc. (TechLaw) personnel.

Surface soil samples are collected to determine the concentration, type, and areal extent of contamination. These samples may be collected as part of a facility-wide investigation, a site-specific investigation, or to locate source areas, provide preliminary screening concentrations, or evaluate background conditions. Surface soil sampling results are also an important component of risk assessment.

The specific procedure and equipment used to collect surface soil samples will depend on variables such as the depth from which samples are to be collected, the type and consistency of the surface soil, and whether the samples are to be collected as a grab or composite sample. Sediments and sludges are collected using the same methods and procedures as those used for surface soil sampling. Surface soils are generally defined as those soils less than two feet below ground surface. Actual sample collection depth must be specifically defined in the site-specific sampling and analysis plan (SAP).

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Category No.	Category Title
01	General Procedures
02	Field Procedures
03	Field Documentation Procedures
04	Packaging and Shipping Procedures
05	Field Equipment Operation and Maintenance Procedures
06	Groundwater Sampling/Monitoring and Analysis Procedures
07	Soil/Sediment Sampling and Analysis Procedures

08	Surface Water Sampling and Analysis Procedures
09	Health and Safety Procedures
10	Regulatory Compliance Procedures
11	Quality Assurance Procedures
12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
14	Asbestos Handling
15	Region 5 ESAT-Specific SOPs
16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Apparatus

This section describes the different equipment requirements and methods used in collecting surface and near surface soil samples.

- Site-specific SAP or quality assurance project plan (QAPP)
- Site-specific health and safety plan (HASP)
- Personal protective equipment (PPE) required by the HASP
- Monitoring/screening instrumentation required by the HASP and the SAP (e.g., organic vapor monitor, dust monitor, etc.)
- Sample supplies (containers, shipping materials, labels, coolers)
- Decontamination supplies
- Sample documentation supplies (chain-of-custody, custody seals, field logbooks)
- Stainless steel and/or Teflon-lined spatulas, pans, bowls, or trays
- Stainless steel and/or Teflon-lined scoops, trowels, or spoons
- Stainless steel hand auger/corer (liners optional)
- Plastic Sheeting
- Sample cooler with ice

- Measuring tape/compass
- Garbage bags

Preparatory Sampling Procedures

This section describes the procedures that need to be followed in preparing for surface and near surface soil samples.

- Locate and mark all potential sampling locations.
- Decontaminate all equipment (see SOP No. 02-03-XX for additional details) associated with sample collection (e.g., bowls, spoons, etc.).
- Prepare sampling locations by removing stones, gravel, vegetation, and other ground covering.
- Calibrate all sampling equipment and monitoring equipment. Document calibrations in logbook.
- Place clean plastic sheeting on the ground near the sampling area and place decontaminated equipment to be used on the plastic (clean, decontaminated equipment must be used for each sample).
- Don appropriate PPE required by the site-specific HASP.

Sampling Procedures

This section describes the procedures that need to be followed in collecting surface and near surface soil samples. Procedures for direct grab and hand auger/hand corer methods are provided.

- Surface soil samples are generally collected from the area of least-contamination to most contamination (if known). Areas in close proximity to sample locations should remain undisturbed until all samples in the area have been collected.
- Volatile organic compound (VOC) samples (and other analytes that degrade with aeration) should be collected first and with the least disturbance possible. VOC samples should also be collected as grab samples unless otherwise specifically dictated by the project data quality objectives or the site-specific SAP. Additionally, VOC sample containers should be filled, compacted as much as possible, and cooled as quickly as

possible to reduce loss of analytes to the atmosphere. See SOP No. 07-08-XX for additional details about collecting VOC soil samples.

- Nonvolatile organic or inorganic samples should be thoroughly mixed with a decontaminated spoon, spatula, or trowel in a decontaminated bowl or tray prior to containerization.

Direct Grab Method

- Insert a decontaminated stainless-steel spoon, trowel, or spatula into the exposed soil to the appropriate sample depth and remove the soil (sufficient volume should be removed to fill all required sample containers (refer to the SAP/QAPP and/or laboratory SOP to ensure the correct sample volume is collected). It is acceptable to use a transfer container of some kind for non-VOC samples as long as all containers in the process are clean and uncontaminated (e.g., scooping soil into a gallon-sized poly zip-top bag and later transferring the material into a glass jar that is shipped to the lab).

- VOC sample material should be placed directly into the sample container (see SOP No. 07-08-XX).

- Nonvolatile organic and inorganic sample material should be placed into a decontaminated stainless-steel bowl or tray or poly zip-top bag and thoroughly mixed (homogenized) with a decontaminated spoon, spatula, or trowel prior to containerization

- Remove non-soil material (e.g., roots, stones, leaves, etc.) using new, uncontaminated nitrile gloves to avoid any possible contamination of the soil sample.

Hand Auger/Hand Corer Method

- Rotate, drive or push a decontaminated hand auger or hand corer into the surface soil to the required depth.

- Retrieve the auger or corer and transfer the material for VOC samples directly into the VOC container (see SOP No. 07-08-XX). After the collection of the VOC samples, transfer the remainder of the auger/core material into a stainless-steel bowl, tray or pan as required by the site-specific SAP/QAPP.

- Nonvolatile organic or inorganic samples should be thoroughly mixed (homogenized) with a decontaminated spoon, spatula, or trowel in a decontaminated bowl or tray or poly zip-top bag) prior to containerization.

- Repeat process until sufficient sample volume has been retrieved. Be sure to check with the SAP/QAPP and/or laboratory SOP to ensure the correct sample volume is collected.

Post Sampling Procedures

- Document and record all pertinent information associated with sample collection in a field logbook (see SOP No. 03-01-XX).
- Label all sample containers and cover the label with clear tape.
- Complete appropriate chain-of-custody forms (see SOP No. 02-05-XX).
- Package and prepare samples for shipping (see SOP Series 04).
- Decontaminate all equipment associated with sample collection (e.g., bowls, spoons, etc.) (see SOP No. 02-03-XX).

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress, which is consistent with Occupation Safety and Health Administration (OSHA) and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed shoes, safety glasses, and chemical-resistant gloves. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged or worn items.

A site-specific HASP must be developed by the Field Team Leader or designee and approved by the TechLaw Health and Safety Director prior to implementation of the field work. The site-specific HASP must be reviewed and signed by all field team members prior to beginning work.

Any deviation(s) from an approved site-specific HASP must be documented in the field logbook.

Quality Assurance/Quality Control (QA/QC)

In addition to adhering to the specific requirements of this SOP and any supplementary site-specific SAP and QAPP requirements or procedures, the minimum QA/QC requirements for these sampling activities are as follows:

Control of Deviations

Any deviations from the planning documents must be fully documented in the field logbook. These deviations must be sufficiently documented to identify the rationale for the deviation and to allow repetition of the activity as actually performed.

Quality Control Samples

The number and type of QC samples, including duplicate samples, matrix spike/matrix spike duplicates, field blanks, equipment rinsate blanks, and trip blanks, will be collected and prepared in accordance with the planning documents and procedures.

QC sample frequencies/requirements will vary dependent on the specific analytical method. Sufficient planning must be made to ensure that the QC frequency/requirements are met on a per analytical method basis.

Verification

Verification is required for the above activities and includes surveillances and periodic record audits. These activities are determined by the TechLaw QA Director on a project by project basis. All surveillances and record audits will be documented and become part of the completed project records.

Comments/Notes

Soil analysis of compounds that may degrade easily by volatilization caused by aeration (e.g., VOCs) must be collected by the grab sampling method. Grab sample collection methods reduce the amount of disturbance and therefore the potential analyte loss. The drawback of using the grab sample collection method is determining the sample representativeness since the sample has been disturbed, is not homogenized, and was collected from a discrete point.

Attachments

None at this time.

References

Mason, B.J. Preparation of Soil Sampling Protocol: Techniques and Strategies, EPA-600/4-83-020. 1983.

TechLaw Consultants, Inc., Corporate Quality Management Plan, current version.

TechLaw Consultants, Inc., Health and Safety Program Plan, current version.

U.S. EPA, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, 2nd Edition, EPA-600/4-84-076, December 1984.

U.S. EPA, Test Methods for Evaluating Solid Waste, SW-846, most recent version.

U.S. EPA, Office of Research and Development, Environmental Monitoring Systems Laboratory, Las Vegas, NV and Environmental Research Center, UNLV, Las Vegas, NV, Soil Sampling Quality Assurance User's Guide, Second Edition EPA/600/8-89/046, March 1989.

U.S. EPA, Compendium of Superfund Field Operations Methods, EPA/540/P87/001, April 1997.

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
07-03-04	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
07-03-05	1/1/2020	Entire document reviewed and updated. Changed company name to TechLaw Consultants, Inc.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

SOIL/SEDIMENT SAMPLING AND ANALYSIS PROCEDURES – SOIL, SOIL GAS, AND GROUNDWATER SAMPLING USING DIRECT PUSH TECHNOLOGY (DPT)

Page 1 of 10
SOP Number 07-07-05
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SOP Description

This Standard Operating Procedure (SOP) describes the collection of soil, soil gas, and groundwater samples by TechLaw Consultants, Inc. (TechLaw) personnel using Direct Push Technology (DPT).

DPT consists of a rugged, lightweight hydraulic drive point system mounted on a vehicle, trailer, or track mounted unit. The DPT system has the capability to drive sampling equipment for the collection of soil, soil gas, and groundwater samples. The DPT unit hydraulically advances hollow rods to a predetermined sampling depth. The media-specific (e.g., soil, vapor, water) type of DPT equipment is then deployed.

DPT should only be performed by experienced personnel who have been trained and performed at least one day of on-the-job training under a qualified operator.

The use of DPT may be a cost-effective alternative to conventional drilling methods for the collection of subsurface soils, soil gas, and groundwater samples. Prior to selecting DPT as a method for sample collection, consideration of the site geology, depth to groundwater, type of soils, site access, and topography must be given. The project data quality objectives and analytical requirements must also be considered. Generally, DPT is used to collect screening-level data.

The use of DPT provides advantages over conventional methods, including:

- Low mast height enables the unit to work safely and effectively at low clearance locations.

- Smaller unit size enables access to areas where size constraints and slope are prohibitive.

- Investigation-derived waste (IDW) (e.g., soil cuttings and purge water) is greatly reduced due to the smaller diameter push rods and soil displacement in the horizontal direction versus the vertical direction towards the surface.

- Cost savings may be realized from the reduction of IDW disposal, daily/weekly/monthly leases versus per foot charges, and efficiency/speed of work completed. A cost-benefit evaluation should be conducted on a project-specific basis.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

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14	Asbestos Handling
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16	Region 8 ESAT-Specific SOPs
17	Region 1 ESAT-Specific SOPs
18	TLI-Specific SOPs

Equipment and Apparatus

Common Equipment Required for DPT

- Site-specific sampling and analysis plan (SAP)
- Site-specific health and safety plan (HASP)
- Personal protective equipment (PPE) required by the HASP
- Monitoring/screening instrumentation required by the HASP and SAP (organic vapor monitor, pH, temperature, conductivity, dissolved oxygen, and turbidity meters)
- Sample supplies (containers, preservatives, shipping materials, labels, coolers)
- Decontamination supplies

- Sample documentation supplies (chain-of-custody, field logbooks)
- DPT unit with the following supplies:
    - Push rods
    - Drive caps and pull caps
    - Carbide-tipped drill bit for drilling pilot holes in asphalt and concrete
    - O-rings
    - Powdered bentonite/concrete

DPT Soil Sampling Equipment

- Steel or stainless steel core sampler
- Steel or stainless steel piston sampler
- Steel or stainless steel split-barrel sampler
- Acetate, brass or stainless steel liners
- Extension rods (chase rods)

DPT Soil Gas Sampling Equipment

- Expendable drive points (one per sample at a minimum)
- Polyethylene tubing or Teflon® lined polyethylene tubing
- Silicone tubing
- Vacuum or sampling system (syringe, peristaltic pump)
- Post Run Tubing (PRT) adapter
- PRT expendable point holder
- Vacuum gauges
- 3-way valves

DPT Groundwater Sampling Equipment

- Expendable drive points (one per sample at a minimum)
- Screen Point groundwater sampler or mill-slotted well point sampler
- Polyethylene tubing or Teflon® lined polyethylene tubing
- Silicone tubing
- Check valves (for Waterra system)
- Peristaltic pump
- Small diameter bailer (mini-bailer or “pencil bailer”)
- Nylon line
- Extension rods (chase rods)
- 1-inch diameter polyvinyl chloride 0.010 slot screen and riser (casing)

Common Procedures for Soil, Soil Gas and Groundwater Sample Collection

Prior to sampling:

- Locate and mark all potential sampling locations.
- Arrange and complete all necessary utility clearances (see SOP 07-01-XX Appendix A).
- Decontaminate all equipment (see SOP 02-03-XX) associated with sample collection (e.g., rods, tips, etc.).
- Prepare sampling locations for equipment access (e.g., clear brush, drill holes in concrete).
- Calibrate all sampling equipment and monitoring equipment.
- Don appropriate PPE required by the site-specific HASP.

After sampling:

- Remove all push rods from the ground.
- Completely fill the borehole with neat cement or bentonite grout, as required.
- Document and record all pertinent information associated with the sample collection in a field logbook (see SOP 03-01-XX).
- Label all sample containers and cover the label with clear tape.
- Complete appropriate chain-of-custody forms (see SOP 02-05-XX).
- Package and prepare samples for shipping (see SOPs 04-02-XX, 04-03-XX and 04-04-XX, as necessary).
- Decontaminate all equipment associated with sample collection (e.g., rods, tips, etc.).

Soil Sampling

- Assemble the sampling device by screwing the cutting shoe onto the bottom of the sampler (unless it is built-in). If using liners or sleeves, they should be placed in the sampler prior to assemblage.
- Thread the piston tip onto the piston rod.
- Thread the drive head onto the top end of the sampler.
- Slide the piston rod into the sampler (the tip of the piston should slightly protrude from the cutting shoe) and reverse thread the piston stop pin onto the top of the piston rod.
- Thread the assembled sampler onto the lead push rod.
- Thread the drive cap onto the lead push rod and advance the sampler with the hydraulic hammer.

- Advance the sampler to the top of the predetermined sample interval by adding necessary push rods and then advancing them with the hydraulic hammer.
- Upon reaching the sample interval, remove the drive cap and lower extension rods down the inside of the push rods until encountering the top of the piston stop pin.
- Rotate the extension rods clockwise until the piston stop pin is removed from the sampler.
- Remove the extension rods with the attached piston stop pin.
- Replace the drive cap and advance the push rods and sampler through the sample interval.
- Remove the drive cap and replace it with the pull cap.
- Retract the push rods and sampler from the borehole (take care to secure the push rods remaining in the hole when removing a push rod to prevent them from falling back down the borehole).
- Detach the sampler from the lead push rod upon retrieval.
- Disassemble the sampler, remove the liner or sleeves, and seal both ends with Teflon or plastic caps. If logging lithology, mark each end with top or bottom orientation.
- If volatile organic compound (VOC) samples are to be collected, the liner should be split shortly after capping (e.g., immediately after screening with an organic vapor analyzer or OVA) to prevent analyte loss. VOCs should be collected as per SOP No. 07-08-XX. Non-VOC samples should then be collected as per SOP No. 07-03-XX.

Soil Gas Sampling

- Test fit the PRT adapter with the PRT expendable point holder or retractable point holder to ensure the threads are compatible and thread together smoothly.
- Attach and secure the PRT adapter to the flexible tubing with wire (flexible tubing must be at least the length of the depth of the sample interval plus approximately 2 feet to work with at the surface).
- Check the condition and placement of the O-ring at the down hole end of the PRT adapter.
- Thread the PRT expendable point holder into the lead push rod.
- Place the expendable drive point into the expendable drive point holder.
- Attach the drive cap to the lead push rod and advance using the hydraulic hammer to a depth approximately one (1) foot past the predetermined sample depth.
- Remove the drive cap and replace it with the pull cap.
- Retract the push rods approximately one (1) foot.
- Lower the extension rods down the inside of the push rods and ensure that the drive point has dropped off the expendable drive point holder. If not, push the drive point off of the expendable point holder.
- Remove the extension rods.

- Insert the PRT adapter end of the flexible tubing down the inside of the push rods until the PRT adapter comes in contact with the expendable point holder.
- Apply a gentle downward pressure to the flexible tubing while rotating in a counter-clockwise direction to thread the PRT adapter into the expendable point holder (Hint: When collecting soil gas from depths greater than 20 feet below ground surface, using a larger diameter tubing will allow for more control when attaching the PRT adapter to the expendable point holder).
- Rotate the tubing until the PRT adapter is snugly threaded into the expendable point holder.
- Pull gently on the tubing to ensure the PRT adapter has been fully threaded into the expendable point holder.
- Connect the tubing to a vacuum pump or sampling system. Insert a short section of silicone tubing between the vacuum pump and down hole tubing if a syringe will be used to collect the sample.
- Start the vacuum pump or sampling system to remove a minimum of three volumes of soil gas from the tubing. Tight formations (clays) may not allow soil gas to pass through, resulting in insufficient purge and sample volumes. Prior to sample collection, the sampling tubing and container configuration must be tested for leaks. Leak detection may be accomplished by pinching off the down hole tubing and applying a vacuum to the system and observing the vacuum gauge.
- Collect the soil gas sample according to one of the following methods:
    - <u>Syringe</u> - Insert the needle attached to a 60 cc syringe into the silicone tubing. Pull the plunger back until the syringe is filled with soil gas. Make sure that the negative pressure within the syringe has equalized prior to removing the syringe from the silicone tubing. If the pressure within the syringe will not equalize, the system is either plugged or the formation is tight and the push rods must be removed, decontaminated (expendable point holder at a minimum), and re-driven.
    - <u>Peristaltic Pump/Tedlar Bag</u> - Attach a peristaltic pump (using silicone tubing) to the down hole tubing and purge a sufficient volume (three times the total system volume consisting of the soil gas tool + tubing inside diameter + open hole interval + in line sampling containers) of soil gas. Attach a Tedlar bag to the exhaust side of the peristaltic pump and fill the Tedlar bag with soil gas. If the system is plugged or the formation will not allow soil gas to permeate, the Tedlar bag will not inflate.
    - <u>Summa Canister</u> - Attach a summa canister in line with a vacuum pump/tank to the down hole tubing using a T-fitting or three-way valve. After completion of an appropriate purge (three times system volume) using the vacuum pump/tank, open the summa canister valve to collect the sample into the evacuated canister.
- After sample collection, pull the down hole tubing off the PRT adapter.
- After removal of the push rods, inspect the PRT adapter and expendable point holder to ensure a complete seal was achieved. If it is apparent that the PRT adapter and

expendable point holder connection was not adequate (e.g., PRT adapter O-ring not properly seated on expendable point holder), the samples must be recollected.

Groundwater Sampling

DPT groundwater sample collection can be completed by using one of three different methods:

- Hydropunch ™ Method - The Hydropunch™ consists of advancing a split-barrel tube containing a retracted stainless steel well screen with an expendable drive point into the aquifer. Upon reaching terminal depth, the push rods are pulled up approximately two (2) feet and the screen is exposed to the aquifer. The screen may need to be pushed out of the split-barrel tube using the extension rods.
- Mill-slotted Well Point Method - The mill-slotted well point method consists of advancing a mill-slotted push rod (lead rod) and expendable drive point into the aquifer. Upon reaching terminal depth, the groundwater flows through the mill-slotted well point for sampling. Note: The mill-slotted well point can become clogged through smearing during advancement to the sampling depth.
- Mini-Well Sampling Method - A temporary mini-well can be placed for sampling. The DPT push rods used for this method are generally a larger diameter and must at least be large enough to lower a 1-inch diameter screen and riser through. To place the mini-well, drive the push rods with an expendable drive point to the desired depth. Lower the 1-inch riser and 1-inch well screen (screened intervals may be of varying length) through the annulus of the push rods. Retract all push rods from the borehole leaving the riser and well screen in place.
- Measure the depth to groundwater.
- Collect the groundwater sample using either a decontaminated mini-bailer, peristaltic pump with flexible tubing, or an inertial pump (Waterra™ type check valve system).

Field Documentation

A permanent record must be maintained for each sampling location. This permanent record is the field logbook, photographs, and in some instances, surveyed locations. Field documentation of soil, soil gas and groundwater sampling using DPT is also required where personnel are conducting field oversight of other contractors on behalf of the U.S. Environmental Protection Agency (EPA), Department of Defense (DoD), Department of Energy (DoE), state agencies, or industrial clients. Photographs should also be taken to document the sampling procedures used in the field. The record/logbook must include the following items in addition to the documentation specified in SOP Nos. 03-01-XX through 03-04-XX and SOP No. 02-05-XX:

- Personnel performing the sampling

- Record of utility clearance
- Sample identification number(s) and location(s) (surveyed if possible)
- Depths of soil, soil gas or groundwater samples
- Any problems encountered during soil boring or sample collection
- Disposition of removed soil not collected as sample

Health and Safety

It is TechLaw's policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress, which is consistent with Occupational Safety and Health Administration (OSHA) and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate PPE. At a minimum, this will include a hardhat, hearing protection, full-face respirator, steel-toed shoes, safety glasses, and chemical-resistant gloves. Personnel are required to inspect their PPE prior to entering any job site and replace any damaged or worn items.

A site-specific HASP must be developed by the Field Team Leader or designee and approved by the TechLaw Health and Safety Director prior to implementation of the field work. The site-specific HASP must be reviewed and signed by all field team members prior to beginning work.

If drilling, or sampling at depth is involved, utility clearance may be necessary. Utility screening and clearance must be discussed in the HASP and all such activities must be performed before drilling. Refer to SOP No. 07-01-XX for utility clearance instructions.

Any deviation(s) from an approved site-specific HASP must be documented in the field logbook.

Quality Assurance/Quality Control (QA/QC)

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific SAP requirements or procedures, the minimum QA/QC requirements for these sampling activities are as follows:

Control of Deviations

Any deviations from the planning documents must be fully documented in the field logbook. These deviations shall be sufficiently documented to identify the rationale for the deviation and to allow repetition of the activity as actually performed.

QC Samples

The number and type of QC samples, including duplicate samples, matrix spike/matrix spike duplicates, field blanks, equipment rinsate blanks, and trip blanks, will be collected and prepared in accordance with the planning documents and procedures. QC sample frequencies/requirements will vary depending on the specific analytical method. Sufficient planning must be conducted to ensure that the QC requirements are met on a per method basis.

Verification

Verification activities are required for the above activities and include surveillances and periodic record audits. These activities are determined by TechLaw Quality Assurance Director or designee on a project-by-project basis. All surveillances and record audits will be documented and become part of the completed project records.

Comments/Notes

DPT sampling systems are not designed for the collection of large sample volumes. This can impact the number and type of analytical parameters collected for during a sampling effort. Dependent upon the type of soils, recovery rates can vary greatly. Aquifer characteristics can also have a tremendous impact on the volume of water that can be retrieved. Depending on the sample depths, sample volumes, experience of personnel, geologic and hydrogeologic conditions and analytical parameters, a typical number of samples that can be collected per day of effort ranges from six (6) to twelve (12).

Practical depths of application for DPT range from the surface to 50 feet below ground surface. However, sampling depths using DPT have been in excess of 100 feet below ground surface in unconsolidated, homogeneous sandy soils.

Prior to conducting DPT activities, it is imperative that underground utilities and structures be identified on the ground surface with spray paint or flags. To ensure that all sample locations are clear of underground utilities and structures, all sample locations should be located prior to having the utility clearance completed, and a representative of TechLaw should be present during the utility clearance (see Attachment A of SOP No. 07-01-XX).

Collection of groundwater samples to be analyzed for VOCs using a peristaltic pump is generally not recommended. Collect VOC samples using a stainless steel bailer first and then use the peristaltic pump to collect the remainder of the required sample volume. If a stainless steel bailer is not available, it is acceptable to collect VOC samples with a peristaltic pump by filling the tubing with water, turning the peristaltic pump off, removing the tubing from the push rods, and filling the VOC vial from the bottom of the tubing taking care not to collect the water in the initial five feet of tubing (tubing closest to the pump). Repeat this process as necessary to fill the required glassware for the VOC analysis. This method is acceptable since the vacuum caused by the peristaltic pump is only presented to approximately the initial one or two feet of tubing. Therefore, the water beyond that point is not as subject to the disturbing effects of the vacuum.

Attachments

None at this time.

References

Geoprobe Systems™, The Probe-Drive Soil Sampling System, September 1991 and more recent related Geoprobe™ publications on DPT.

TechLaw Consultants, Inc., Corporate Quality Management Plan, current version.

TechLaw Consultants, Inc., Health and Safety Program Plan, current version.

Transglobal Environmental Geochemistry, The Stratoprobe™ System, Direct Push Technology for Soil, Water and Soil Vapor Sampling, 1996.

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U.S. EPA, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, Available Sampling Methods, 2nd Edition, EPA-600/4-84-076, December 1984.

U.S. EPA, Test Methods for Evaluating Solid Waste, SW-846, most recent version.

RECORD OF CHANGES/REVIEW

Rev. Number	Revision/ Review Date	Changes Made (If other than entire document, list sections)
07-07-04	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
07-07-05	1/1/2020	Entire document reviewed and updated. Changed company name to TechLaw Consultants, Inc.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

WASTE SAMPLING AND ANALYSIS PROCEDURES – DRUM OR CONTAINER SAMPLING AND ANALYSIS PROCEDURE

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SOP Number: 13-02-04
Effective Date: 1/1/20

Technical Approval: ________________________________ Date: 1/1/2020

QA Management Approval: David E. Dobb Date: 1/1/2020

SOP Description

This Standard Operating Procedure (SOP) describes the procedural methods, equipment, and apparatus used by TechLaw Consultants staff when collecting samples from drums or containers. The sample collection may be performed for a variety of reasons including waste characterization or sampling to determine treatment, storage, and disposal facility options. This SOP is typically applicable to all drum, container, or tank sampling operations (up to 120 gallons). However, due to a wide variety of site conditions and other limitations encountered in the field, modification to these procedural methods may be necessary to meet the required needs of the sampler. All modifications should receive approval from the Contract Manager and thorough documentation of rationale for modification should be recorded, as specified in the Field Documentation Section of this SOP.

General Procedures

Related SOPs

This SOP is to be used in conjunction with and must be referenced when developing, reviewing, issuing, revising, or retiring SOPs in any of the following categories:

Section No.	Section Title
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10	Regulatory Compliance Procedures
11	Quality Assurance Procedures

12	Incineration/BIF Sampling and Analysis Procedures
13	Waste Sampling and Analysis Procedures
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15	Region 5 ESAT-Specific SOPs
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18	TLI-Specific SOPs

Pre-Sampling Procedures

Inventory

Once the need to sample a drum, container, or tank has been established, the drums, containers, or tanks must be inventoried, staged and opened. An inventory entails recording visual observations of each container including markings, condition, and location. The observations of the containers must be recorded in the field logbook. The form in Attachment A can also be used. Before the containers are staged, photograph and sketch in logbook the containers in their original location. Refer to SOP No. 03-01-XX, Maintenance of a Field Logbook, and SOP No. 03-02-XX, Taking and Documenting Photographs, for appropriate information and observations to be recorded.

Note: Staging and opening operations are to be performed by facility or subcontractor personnel. TechLaw Consultants personnel are not to perform these operations.

***CAUTION*: Do not move drums that have been over pressurized to the extent that the head is swollen several inches above the level of the rim or the sides of the drum are swollen. The practice of tapping drums to determine their contents is neither safe nor effective and should not be used if the drums are visually over pressurized or if shock-sensitive materials are suspected.**

Staging

Staging involves the segregation or consolidation of containers based on suspected similar wastes or characteristics. Drums should only be handled if necessary. As needed, the container to be sampled should be staged to allow easy access. Ideally, the staging area should be located just far enough from the container opening area to prevent a chain reaction if one container should explode or ignite upon opening. **Staging should**

be conducted by the facility personnel or a subcontractor. TechLaw Consultants personnel should only provide direction and input about staging of drums. Non-essential workers should not be allowed in the area, and spill containment supplier should be on hand, if needed. If staging is necessary, the following precautions and actions should be taken:

Drums, containers, or tanks can be classified into the following categories: those containing liquids, those containing solids and/or sludges, lab packs, gas cylinders, and those which appear empty. Solids and sludges are typically disposed of in open-top containers. Closed-head containers, such as drums with a bung opening, generally contain liquid. Drums that have an open-top lid and a bung opening may contain either type of material. Facility personnel are usually the most reliable source of information for determining the contents of each container.

If the sampler suspects that some containers contain radioactive, explosive, air reactive and/or shock-sensitive materials, these containers should be staged in a separate, isolated area and care should be taken by TechLaw Consultants personnel to maintain a safe distance from the handling of the containers. Placement of explosives and shock-sensitive materials in diked and fenced areas will minimize the hazard and the adverse effects of premature detonations.

If staging is necessary, the sampling area should be physically separated from the container removal and container staging operations. Containers are moved by the facility personnel or subcontractor from the staging area to the container opening area one at a time using appropriate equipment such as a forklift truck equipped with a drum grabber or a barrel grappler, by facility personnel. Containers should be prioritized for sampling, based on opening and sampling strategy developed for each. Small containers may be transferred manually if the facility operator or subcontractor feels that operation would be safe. At small facilities, specialized equipment may not be available to the facility personnel. In that situation, request that facility personnel move the containers in their usual manner used during normal day to day activities.

After the containers have been staged, photograph an overall view of the containers and sketch the containers staging area, indicating the total number of containers and the visual characteristics of each container in the field logbook. The form in Attachment A can also be used. To record the visual qualities, create a table in the field logbook that uniquely identifies each of the containers, type of containers, any placards and labels on the container, pertinent markings on container, the color of the container, condition of the container, (note any leakage, signs of over pressurization, rusting, corrosion, etc.), and field screening detector readings prior to opening.

Opening

After visual information for each container has been recorded, the next step is to open the containers. Use of non-sparking tools (i.e., brass, bronze, etc.) is necessary during container opening operations. ***CAUTION*****: Have the facility personnel or facility subcontractor open the containers. Do not have the facility personnel open containers that appear to have been over pressurized.** If the containers are over pressurized, notify the client of the concern. The client should decide if another container is to be sampled.

After the containers have been opened, record the estimated volume of material in each container, description of material in the each container (color, viscosity, odor, number of phases), and record any field screening results from organic vapor monitor such as a photoionization detector (PID) or flame ionization detector (FID); explosimeter/oxygen meter readings; pH, Toxic Vapor Analyzer (TVA) readings, chlorinated oil test kits, color indicating strips, etc. for each container. The field screening results can be used to determine if any of the containers will require sampling, and, if so, which the specific container or containers are to be sampled.

Equipment/Apparatus

Equipment required for drum, container, or tank sampling is simple and readily available and may include the following types:

- **COLIWASA** – The Composite Liquid Waste Sampler (COLIWASA) is designed to collect a sample from the full depth or intermediate depth of a drum or container and maintain it in the transfer tube until delivery to the sample bottle.

- **Thief Sampler** – The thief sampler is also known as the drum thief or glass thief. It is used for sampling drum liquids and it comes in varying lengths and diameters.

- **Bomb Sampler** – The Bomb Sampler is a stainless steel sampler that fits easily into most openings and has a weighted plunger that seals the sample collection chamber. The sample can be obtained from any discrete depth with this device.

- **Telescopic Dipper** – Dipper handle is made in various lengths, normally out of aluminum tubing. Ladle is normally 600mL precleaned polypropylene.

See Attachment B for a field checklist of equipment to be used.

General Considerations

The following paragraphs provide information for determining when to use a COLIWASA, thief sampler, telescopic dipper, or bomb sampler. Selection will be determined by the media to be sampled, type of sample needed, decontamination concerns, and cost of sampling equipment.

COLIWASA

The unit is used to collect liquids and some forms of sludges that are not solidified. It can fit into a small opening and can obtain a sample at a depth of approximately 40 inches:

Advantages
- It is best utilized to collect samples from drums or tanks at different depths or phases at shallow depths.
- It is disposable and does not require decontamination.

Disadvantages
- It may not be strong enough to penetrate some sludges.
- It is difficult to decontaminate and the unit is relatively expensive (compared with the thief sample).

Thief Sampler (or Drum Thief)

The unit is used to collect liquid samples. It can be used to collect samples from containers of all sizes.

Advantages

- It is cost effective, simple, quick, and disposable.

Disadvantages
- During use, it may break.
- Can only be used to collect liquids or soft sludges

Bomb sampler

The unit is used to collect liquids and some forms of sludge samples that are not solidified. It can fit into small openings and can obtain samples at any depth.

Advantages
- The depth at which the Bomb sampler works is only limited by the length of the rope used.
- It is best utilized for containers deeper than 40 inches, such as tanks or tankers.
- It can be used to collect samples at different depths or samples with phases.

Disadvantages
- It is not disposable and does require decontamination after every sample.
- The plunger works under gravity, and its ability to operate as designed may be impacted in highly viscous materials.

Telescopic Dipper

A Telescopic dipper is used to collect liquids and some forms of sludge samples that are not solidified.

Advantages
- It is best utilized for tanks with larger openings or impoundments;
- The ladle is disposable and does not require decontamination.

Disadvantages
- It can be used to collect samples only at the surface.

Sampling Procedures

COLIWASA and Thief Samples

1. Advance the dedicated COLIWASA or Thief sampler into the container to the desired depth or almost to the bottom of the container, or until a solid layer is encountered.

2. About one foot of glass tubing should extend above a drum upon complete entry into container.

3. If an intermediate depth is desired, seal the end with the plunger (COLIWASA only) or place your thumb over the end of the tube and lower the COLIWASA or thief sampler to the desired depth. Once the desired depth has been reached, release the plunger or remove the seal or thumb. It may be necessary to rotate the plunger to break the seal once the COLIWASA has been placed in the media to be sampled. Allow the waste in the container to reach its natural level in the tube.

4. After the tube is filled, seal the plunger (it may be necessary to rotate the plunger again slightly) or place your thumb over the end of the tube to create a vacuum. Hold the tube with both hands, (careful not to touch waste material) and slowly withdraw the COLIWASA or thief sampler from the container.

5. The sample container should be placed close to the COLIWASA or thief sampler (typically on top of the drum or container if large enough) so that when the COLIWASA or thief sampler is removed from the container, the contents can immediately be placed into the sample container. Paper towels may be placed on top of the container to catch any drippage off the COLIWASA or thief sampler.

6. Carefully place the tip of the COLIWASA or thief sampler into the sample container and slowly loosen the plunger (COLIWASA only) or your thumb. If the material is discharged too rapidly into the sample container, it could spill out to the surrounding area. During sample extraction, rotating the COLIWASA plunger slightly allows the seal to be gently broken allowing for a more even discharge of the media being sampled. Remember, the media is under pressure from the weight of the media in the full plunger and will ***rapidly*** discharge if not controlled.

7. Once the designated sample volume has been obtained, cap the sample container tightly, clean exterior of the container, and place sample container in a carrier.

8. Once all sample volumes are collected from the container, the COLIWASA or thief sampler may be returned into the opening of the container. Break the COLIWASA or glass thief by applying pressure to the COLIWASA or glass thief along the side of the drum. Place all pieces into the drum. It should be noted that in some instances disposal of the tube by breaking it into the drum may interfere with eventual plans for the removal of its contents. This practice should be cleared with the client and/or facility personnel.

Bomb Sampler

1. Advance the sampler into the container. Once the sampler has reached the required depth, activate the pull line to shut the sampler closed.

2. In use, the samplers require two lines, one to raise and lower the sampler and one to open the valve assembly. The valve assembly can also be opened automatically when the sampler contacts a hard surface, such as the bottom of a tank or it may be manually activated by the operator at various depths with the use of a pull line.

3. When raised, the plunger automatically reseals closing off the inlet port and locking the sample in place.

4. Slowly withdraw the sampler from the container (careful not to touch waste material).

5. Once the designated sample volume has been obtained, cap the sample container tightly, clean the container with paper towel, and place sample container in a carrier.

6. Once all sample volumes are collected from the container, remove excess waste material from bomb sampler and decontaminate the sampler prior to use in subsequent sampling. If a disposable sampler is used, it can be handled as contaminated trash.

Telescopic Dipper

1. Place disposable plastic beaker into the telescopic arm and tighten clamp.

2. Extend the telescopic pole to the appropriate length to access the area from which the sample will be collected.

3. Slowly place the beaker into the material and lower. Allow liquid material to fill the beaker.

4. Lift the beaker out of the material and pull the pole back towards you (careful not to come in contact with waste material).

5. Place the mouth of the beaker onto the sample container and slowly fill the container.

6. Once the designated sample volume has been obtained, cap the sample container tightly, clean the exterior of the container, and place sample container in a carrier.

7. Once all sample volumes are collected from the container, remove the beaker from the telescopic arm and place with contaminated trash. Upon approval from facility representatives, contaminated trash may be left with the facility for proper disposal.

8. The telescopic pole must be decontaminated before placed back into use.

Completion of Sampling Procedures

1. Replace the bung or cover on the container.

2. Photo documentation of the samples and each container sampled is recommended.

3. Package, label, and prepare for shipment as specified in SOP No. 02-05-XX, Chain-of-Custody; SOP 04-03-XX, Environmental Samples; and SOP No. 04-04-XX, Waste Samples.

4. Complete the field logbook and chain-of-custody forms in accordance with the SAP and appropriate SOPs as stated above.

Contamination Control

Sampling tools and equipment must be protected from sources of contamination prior to sampling. Sample containers must also be protected from sources of contamination. Sampling personnel must wear chemical-resistant gloves when handling the sampling equipment and samples. Gloves must be replaced between samples.

Health and Safety

It is TechLaw Consultants' policy to maintain an effective program for control of employee exposure to chemical, radiological, and physical stress which is consistent with Occupation Safety and Health Administration (OSHA) and other applicable and appropriate established standards and requirements.

All field personnel will be provided with appropriate personal protective clothing and safety equipment. At a minimum, this will include a hardhat, hearing protection, full-face respirator with appropriate cartridges, safety-toed safety shoes, safety glasses and chemical-resistant gloves. Personnel are required to inspect their Personal Protective Equipment (PPE) prior to entering any job site and replace any damaged items.

A site-specific health and safety plan must be developed by the field team leader or designee and approved by the Health and Safety Director (HSD) or Health and Safety Officer prior to implementation in the field. This plan must be reviewed with the field team members prior to beginning work.

Any deviation(s) from an approved site-specific health and safety plan must be documented in the field logbook.

The opening of closed containers is one of the most hazardous site activities. Maximum efforts should be made to ensure the safety of the sampling team. Proper protective equipment and a general awareness of the possible dangers will minimize the inherent risk during sampling operations. Use remote sampling equipment whenever feasible.

QA/QC

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site-specific procedures, the minimum Quality Assurance/Quality Control (QA/QC) requirements for this sampling activity are the following.

Control of Deviations

When feasible, any departure from specified requirements will be justified and authorized prior to deviating from the requirements. Deviation shall be documented sufficiently to allow repetition of the activity as actually performed.

QC Samples

The number and types of QC samples including duplicate samples, field blanks, equipment blanks, and trip blanks will be collected or prepared as specified in the SAP.

Verification

Verification activities are required for the above practices including surveillance and periodic record audits. These activities will be documented and become part of the completed project records.

Field Documentation

A permanent record must be maintained for each sampling event. This permanent record includes the field logbook, photographs, and in some instances, surveyed locations. Photographs should also be taken to document the sampling procedures used in the field. The record/logbook must include the following items:

- Time and date of sampling activity;
- Weather conditions;
- Personnel performing the sampling;
- Unique identity assigned to each container sampled;

- Sample identification number(s) and associated container identification;
- Depths from which sample was collected;
- Any problems encountered during container staging and sample collection;
- Disposition of disposable sampling equipment;
- Description of media sampled including color, viscosity, phasic properties;
- Documentation of the presence or absence of:
    - Organic material (e.g., leaves, roots, algae); and
    - Odors (e.g., organic, petroleum, solvent, putrid).
- Deviation from SAP or QAPP.

Comments/Notes

None at this time.

Attachments

Attachment A – Container Observations Form
Attachment B – Field Checklist

References

TechLaw Consultants, Inc., Health and Safety Program Plan, current version.

TechLaw Consultants, Inc., Quality Management Plan, current version.

U. S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14, Washington, D.C., 1987.

U.S. Environmental Protection Agency, Characterization of Hazardous Waste Sites – A Methods Manual, EPA/600/4-84-075, April, 1985.

ATTACHMENT A [Revised 1/1/20]
SOP Number: 13-02-04

CONTAINER OBSERVATION FORM

PAGE ( )

Project: ____________________________ **Container ID:**__________________

Container Type:____

Container Condition: ____

Container Label: ____

Container Label Condition: ____

Observations:____

____

____

____

____

____

Safety Concerns:____

HAZCAT
Observations:____

____

____

____

____

____

HAZCAT
Results:____

ATTACHMENT B [Revised 1/1/20]
SOP Number: 13-02-04

FIELD CHECKLIST

____ COLIWASA Tubes*

____ Telescopic Dippers

____ Wrench

____ Logbook

____ Sample Containers with Lids

____ Safety Glasses or Monogoggles

____ Gloves*

____ Safety Shoes

____ Ice/Cooler, as required

____ Black Indelible Ink Pen

____ Labels

____ Bomb Sampler

____ Drum Thief

____ Scoops*

____ Buckets

____ Plastic Sheets

____ Lab Wipes/Paper Towels

____ Decontamination Equipment**

____ Chain-of-Custody forms

____ Custody Seals, or Evidence Tape

____ Sampling and Analysis Plan

____ Health and Safety Plan

____ Appropriate Containers for Waste and Equipment

____ Camera (and Film if applicable)

____ Health and Safety Monitoring Equipment (per HASP)

____ Copy of this SOP

* Provide sufficient numbers to minimize decontamination activities in the field.

** See SOP No. 02-03-XX for decontamination of sampling equipment.

TECHLAW CONSULTANTS, INC.
STANDARD OPERATING PROCEDURES

WASTE SAMPLING AND ANALYSIS PROCEDURES – DRUM OR CONTAINER SAMPLING AND ANALYSIS PROCEDURE

SOP Number: 13-02-04
Effective Date: 1/1/20

RECORD OF CHANGES/REVIEW

Rev. Number	**Revision/ Review Date**	**Changes Made (If other than entire document, list sections)**
13-02-03	4/22/2016	Revised to apply to TechLaw Holdings and Subsidiary Companies.
13-02-04	1/1/2020	Reviewed for overall changes, minor changes throughout, added new attachment A, revised company name to TechLaw Consultants, Inc.

APPENDIX F.4

LABORATORY – STANDARD OPERATING PROCEDURES

Quality Systems Manual

Volume XIV, Revision I: November 2019

Caitlin Brice

Caitlin Brice, General Manager, Technical Director

Svetlana Izosimova

Svetlana Izosimova, Ph.D., Quality Assurance Officer

SGS North America, Inc. - Orlando.
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407.425.6700

The SGS North America, Inc - Orlando (acceptable designation is **SGS - Orlando**) Quality Assurance Program, detailed in this plan, has been designed to meet the quality program requirements of the National Environmental Laboratories Accreditation Conference (TNI), DoD QSM Ver 5.3, 2019, and ISO 17025. The plan establishes the framework for documenting the requirements of the quality processes regularly practiced by the Laboratory. The Quality Assurance Officer is responsible for changes to the Quality Assurance Program, which are appended to the Laboratory Quality Systems Manual (LQSM) as they occur. The plan is reviewed annually for compliance purposes by the General Manager and Technical Director and edited if necessary. Changes that are incorporated into the plan are summarized in the plan introduction. Changes to the plan are communicated to the general staff in a meeting conducted by the Quality Assurance Officer following the plan's approval.

The SGS - Orlando plan is supported by standard operating procedures (SOPs), which provide specific operational instructions on the execution of each quality element and assure that compliance with the requirements of the plan are achieved. SGS - Orlando employees are responsible for knowing the requirements of the SOPs and applying them in the daily execution of their duties. These documents are updated as changes occur and the staff is trained to apply the changes.

At SGS - Orlando, we believe that satisfying client requirements and providing a product that meets or exceeds the standards of the industry is the key to a good business relationship. However, client satisfaction cannot be guaranteed unless there is a system that assures the product consistently meets its design requirements and is adequately documented to assure that all procedural steps are executed and are traceable.

This plan has been designed to assure that this goal is consistently achieved and the SGS - Orlando product withstands the rigors of scrutiny that are routinely applied to analytical data and the processes that support its generation.

SGS - Orlando is a permanent location facility and is part of SGS, North America, Inc. (SGS-NAM), Environmental Health and Safety (EHS) Division

Summary of Changes
SGS - Orlando Quality System Manual –November 2019

Section	Description	Page #
Entire document	Updated DoD QSM references to 5.3 and TNI to 2016	
Title Page	new revision number	Title
OrgChart	Updated OrgChart,	8
Entire document	replaced CEO/President with VP of EHS	
4	Updated Inorganics Supervisor duties and removed Metals Supervisor	19
Entire Document	Added Technical Director responsibilities to General Manager	
5	Updated signatory approvals	22
6	LQSM and SOP distribution procedure updated	25
8.4	MDL procedure update	33
App II	Updated methods and methods' revisions.	Entire section
App III	Updated instrumentation list	89

Table of Contents

Appendices

QUALITY POLICY

SGS North America, Inc. - Orlando Mission:

SGS - Orlando provides analytical services to commercial and government clients in support of environmental monitoring and remedial activities as requested. The Laboratory's mission is dedicated to providing reliable data that satisfies the client's requirements as explained in the following: "Provide easy access, high quality, analytical support to commercial and government clients which meet or exceeds data quality objectives and provides them with the data needed to satisfy regulatory requirements and/or make confident decisions on the effectiveness of remedial activities."

These services are provided impartially and are not influenced by undue commercial or financial pressures, which might impact the staff's technical judgment. Coincidentally, SGS - Orlando does not engage in activities that endanger the trust in our independent judgment and integrity in relation to the testing activities performed.

Policy Statement:

The management and staff of SGS - Orlando share the responsibility for product quality and continually strive for its systematic improvement. Accordingly, SGS Orlando's quality assurance program is designed to assure that all processes and procedures, which are components of environmental data production, meet established industry requirements, are adequately documented from a procedural and data traceability perspective, and are consistently executed by the staff. It also assures that analytical data of known quality, meeting the quality objectives of the analytical method in use and the data user's requirements, is consistently produced in the laboratory. This assurance enables the data user to make rational, confident, cost-effective decisions on the assessment and resolution of environmental issues.

The laboratory Quality System also provides the management staff with data quality and operational feedback information. This enables them to determine if the laboratory is achieving the established quality and operational standards, which are dictated by the client or established by regulation, such as TNI, ISO 17025 or DoD QSM 5.3 revisions. The information provided to management, through the QA program, is used to assess operational performance from a quality perspective and to perform corrective action as necessary.

Caitlin Brice

Caitlin Brice, General Manager

ORGANIZATION

Organizational Entity. SGS - Orlando, Inc. is a testing laboratory founded in 1956 and registered as a New Jersey Corporation. In 2016 the laboratory has changed ownership to SGS - Orlando Inc, while operations, staff and physical locations were not affected by the change, and fully transitioned into SGS North America, Inc. as of January 2018. SGS NAM headquarters are located in Rutherford, New Jersey.. Satellite laboratories are maintained in Dayton, New Jersey; Syracuse, New York; Wilmington, North Carolina; Anchorage, Alaska; Orlando, Florida; Denver, Colorado; Lafayette, Louisiana; and Houston, Texas.

Legal designations of the individual facilities follow SGS - North America, Inc – Location convention, i.e. SGS - North America, Inc. – Orlando. Legal designation of the laboratory must be used on all certification and licensure documentation. It is acceptable to display abbreviated regional designation on documents other than certificates and licenses. Example – data report from Orlando facility may be branded SGS - Orlando.

Management Responsibilities

Requirement: Each laboratory facility will have an established chain of command. The duties and responsibilities of the management staff are linked to the VP of SGS - North America, Inc, EHS division who establishes the agenda for all company activities.

VP of EHS North America. Primarily responsible for all operations and business activities. Delegates authority to laboratory directors, laboratory managers, and quality assurance director to conduct day-to-day operations and execute quality assurance duties. Each of the individual operational entities (New Jersey, New York, North Carolina, Alaska, Florida, Colorado, Louisiana, and Texas) reports to the VP of EHS.

Corporate Quality Assurance Director. Responsible for design, oversight, and facilitation of all quality assurance activities established by the Quality Program. Directly reports to the VP of EHS.

Chief Information Officer: Maintains and develops LIMS and various EDD formats to suit clients' requests. Maintains cyber security and confidentiality. Delegates daily LIMS operation to local labs.

Laboratory Director/General Manager. A Laboratory Director/General Manager is assigned to each of the following operational entities: New York, Alaska, North Carolina, New Jersey, Florida, Louisiana, Texas, and Colorado. The Laboratory Director executes day-to-day responsibility for laboratory operations including technical aspects of production activities and associated logistical procedures. The Laboratory Director reports directly to the VP of EHS.

Quality Assurance Officer *(on location).* Responsible for oversight, implementation and facilitation of all quality assurance activities established by the Quality Program. Reports to the Corporate QA Director. Also exchanges information with and submits laboratory performance data (PE scores, audit reports, accreditation changes, etc.) with Laboratory Director/General Manager. Takes program directions from Corporate QA Director.

Technical Director. Responsible for oversight and implementation of all technical aspects of production activities in the environmental testing laboratory, including method development and compliance. Laboratory Director/General Manager is designated as Technical Director on location.

In the event that the technical director, quality assurance officer, or laboratory director is absent for a period of time that exceeds 15 consecutive calendar days, the designated appointees shall temporarily perform the technical director, quality assurance officer's, or laboratory director's job function. If this absence exceeds 65 consecutive calendar days, the Accreditation Body(ies), including DoD ELAP, will be notified in writing. Current list of appointed deputies located in restricted access controlled document directory.

Project Manager/Customer Service Manager: primary contact for clients requesting laboratory services. Evaluates and processes client specifications for routine and non-routine analytical services. Identifies, evaluates, and documents the requested specifications to determine if adequate resources are available to perform the analysis. Communicates the specifications to the laboratory staff for execution and verifies that specifications have been executed.

Purchasing Manager (Corporate): Evaluates vendors of services and supplies following established policies. Procures services and supplies. Maintains purchasing documentation and database.

Department Supervisor. Executes day-to-day responsibility for specific laboratory areas including technical aspects of production activities and associated logistical procedures. Orders consumable supplies, inspects supplies upon receipt. Directly reports to the Technical Director and Laboratory Manager.

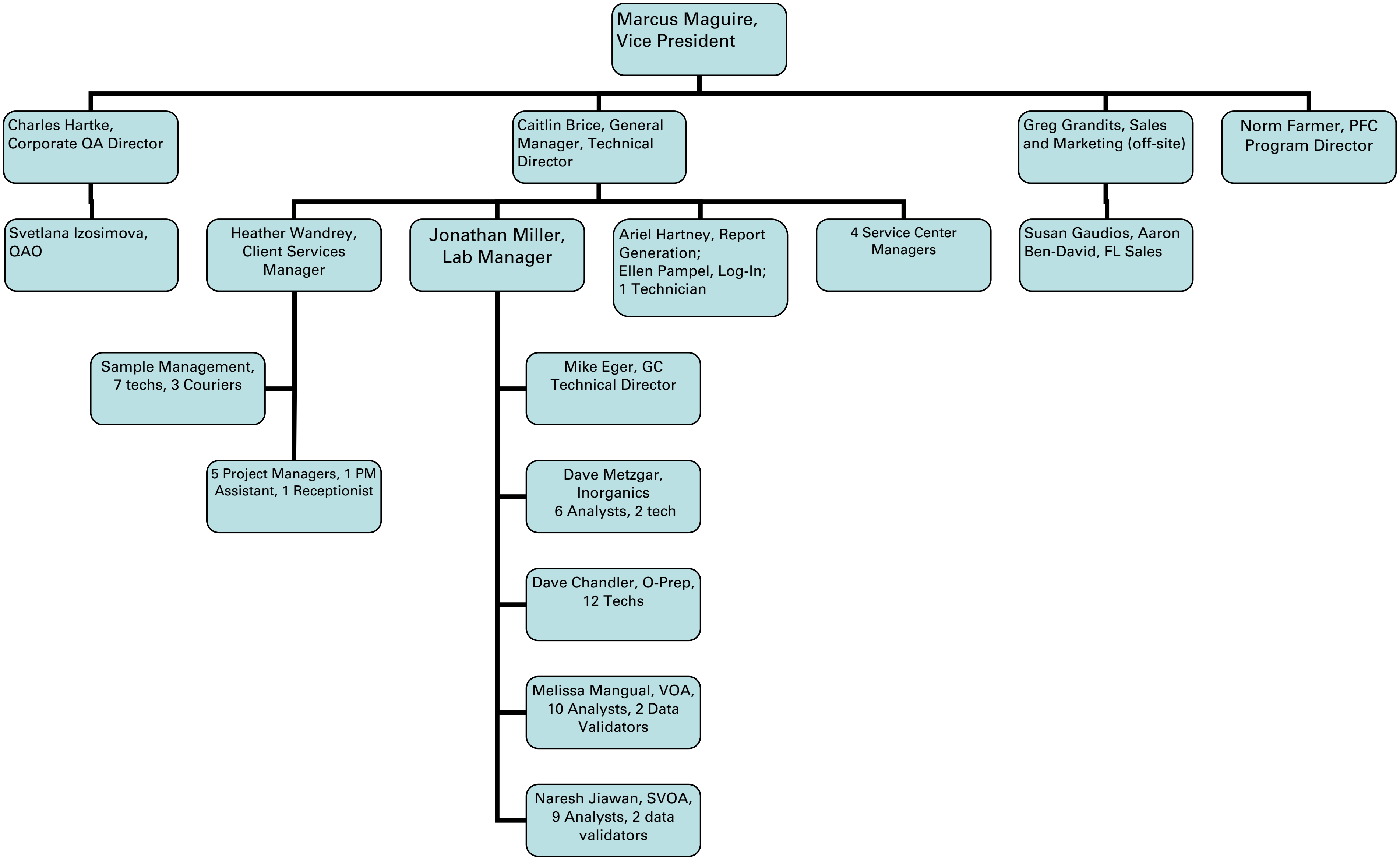
Team Leader*.* Executes day-to-day responsibility for specific laboratory units including technical aspects of production activities and associated logistical procedures. Directly report to the Department Supervisor.

Chain of Command

The responsibility for managing all aspects of the Company's operation is delegated to specific individuals, who have been assigned the authority to act in the absence of the senior staff. These individuals are identified in the following Chain of Command:

Caitlin Brice, General Manager (Operations)
Heather Wandrey, Client Service Manager

SGS - Orlando Organizational Chart



QUALITY RESPONSIBILITIES OF THE MANAGEMENT TEAM

***Requirement*:** Each member of the management team has a defined responsibility for the Quality Program. Program implementation and operation is designated as an operational management responsibility. Program design and implementation is designated as a Quality Assurance Responsibility.

VP of SGS EHS North America*:* Primary responsibility for all quality activities. Delegates program responsibility to the Quality Assurance Director. Serves as the primary alternate in the absence of the Quality Assurance Director. Has the ultimate responsibility for implementation of the Quality Program.

Laboratory Director/General Manager*.* Responsible for implementing and operating the Quality Program in all laboratory areas. Responsible for the design and implementation of corrective action for defective processes. Has the authority to delegate Quality Program implementation responsibilities.

Corporate Quality Assurance Director*.* Responsible for design, implementation support, training, and monitoring of the quality system. Identifies product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Quality Assurance Officer *(on location).* Responsible for design support, implementation support, and monitoring support of the quality system. Training personnel in various aspects of quality system. Conducts audits and product reviews to identify product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Technical Director. Responsible for oversight and implementation of technical aspects of Quality System as they are integrated into method applications and employed to assess analytical controls on daily basis. The Technical Director reviews and acknowledges the technical feasibility of proposed quality system involving technical applications. Empowered with the authority to halt production if warranted by quality problems.

Laboratory Manager. Responsible for oversight and implementation of various aspects of Quality System as they are integrated into method applications and employed to assess analytical controls on daily basis. The Laboratory Manager reviews and acknowledges the technical and logistical feasibility of proposed quality system involving technical applications. Empowered with the authority to halt production if warranted by quality problems.

Department Supervisors. Responsible for applying the requirements of the Quality Program in their section and assuring subordinate supervisors and staff apply all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Team Leaders. Responsible for applying the requirements of the Quality Program to their operation and assuring the staff applies all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Bench Analysts. Responsible for applying the requirements of the Quality Program to the analyses they perform, evaluating QC data and initiating corrective action for quality control deficiencies within their control. Implements global corrective action as directed by superiors.

Program Authority:

Authority for program implementation on corporate level originates with the VP of EHS North America who bears ultimate responsibility for program design, implementation, and enforcement of requirements. This authority and responsibility is delegated to the Director of Quality Assurance who performs quality functions independently without the encumbrances or biases created by operational or production responsibilities to ensure an honest, independent assessment of quality issues.

Laboratory Director/General Manager and Quality Assurance Officer mirror this authority on location.

Data Integrity Policy:

The SGS - Orlando Data Integrity Policy reflects a comprehensive, systematic approach for assuring that data produced by the laboratory accurately reflects the outcome of the tests performed on field samples and has been produced in a bias free environment by ethical professionals. The policy includes a commitment to technical ethics, staff training in ethics and data integrity, an individual attestation to data integrity and procedures for evaluating data integrity. Senior management assumes the responsibility for assuring compliance with all technical ethics elements and operation of all data integrity procedures. The staff is responsible for compliance with the ethical code of conduct and for practicing data integrity procedures.

The SGS - Orlando Data Integrity Policy is as follows:

"SGS - Orlando is committed to producing data that meets the data integrity requirements of the environmental regulatory community. This commitment is demonstrated through the application of a comprehensive data integrity program that includes ethics and data integrity training, data integrity evaluation procedures, staff participation and management oversight. Adherence to the specifications of the program assures that data provided to

our clients is of the highest possible integrity and can be used for decision making processes with high confidence.”

Data Integrity Responsibilities

***Management*.** Senior management retains oversight responsibility for the data integrity program and retains ultimate responsibility for execution of the data integrity program elements. Senior management is responsible for providing the resources required to conduct ethics training and operate data integrity evaluation procedures. They also include responsibility for creating an environment of trust among the staff and being the lead advocate for promoting the data integrity policy and the importance of technical ethics.

***Staff*.** The staff is responsible for adhering to the company ethics policy as they perform their duties and responsibilities associated with sample analysis and reporting. By executing this responsibility, data produced by SGS - Orlando retains its high integrity characteristics and withstands the rigors of all data integrity checks.

The staff is also responsible for adhering to all laboratory requirements pertaining to manual data edits, data transcription and data traceability. These include the application of approved manual peak integration and documentation procedures. It also includes establishing traceability for all manual results calculations and data edits.

***Ethics Statement*.** The SGS - Orlando ethics statement reflects the standards that are expected for businesses that provide environmental services to regulated entities and regulatory agencies on a commercial basis. The Ethics Policy is comprised of key elements that are essential to organizations that perform chemical analysis for a fee. As such, it focuses on elements related to personal, technical and business activities.

SGS - Orlando provides analytical chemistry services on environmental matters to the regulated community. The data the company produces provides the foundation for determining the risk presented by a chemical pollutant to human health and the environment. The environmental industry is dependent upon the accurate portrayal of environmental chemistry data. This process is reliant upon a high level of scientific and personal ethics.

It is essential to the Company that each employee understands the ethical and quality standards required to work in this industry. Accordingly, SGS - Orlando has adopted a code of ethics, which each employee is expected to adhere to as follows:

- Perform chemical and microbiological analysis using accepted scientific practices and principles.

- Perform tasks in an honest, principled and incorruptible manner inspiring peers & subordinates.

- Maintain professional integrity as an individual.

- Provide services in a confidential, honest, and forthright manner.

- Produce results that are accurate and defensible.

- Report data without any considerations of self-interest.

- Comply with all pertinent laws and regulations associated with assigned tasks and responsibilities.

Data Integrity Procedures.

Four key elements comprise the SGS - Orlando data integrity system:

1) data integrity training,

2) signed data integrity documentation for all laboratory employees,

3) in-depth, periodic monitoring of data integrity, and

4) data integrity procedure documentation.

Procedures have been implemented for conducting data integrity training and for documenting that employees conform to the SGS – Orlando Data Integrity and Ethics policy.

The data integrity program consists of routine data integrity evaluation and documentation procedures to periodically monitor and document data integrity. These procedures are documented in SOPs. SOPs are approved and reviewed annually following the procedures employed for all SGS - Orlando SOPs. Documentation associated with data integrity evaluations is maintained on file and is available for review.

Data Integrity Training. SGS – Orlando employees receive technical ethics training during new employee orientation. Employees are also required to attend annual ethics refreshment training and sign an ethical conduct agreement annually, which verifies their understanding of SGS – Orlando's technical ethics policy and their ethical responsibilities. The agreement is refreshed annually and appended to each individual's training file.

The training focuses on the reasons for technical ethic training, explains the impact of data fraud on human health and the environment, and illustrates the consequences of criminal fraud on businesses and individual careers. Multiple examples of prohibited practices are reviewed and discussed. SGS - Orlando's ethics policy and code of ethics are reviewed and explained for each new employee.

Training on department-specific data integrity procedures are conducted by individual departments for groups involved in data operations. These include procedures for manual chromatographic peak integration, standards traceability, etc.

Data Integrity Training Documentation. Records of all data integrity training are maintained in individual training folders. Attendance at all training sessions is documented and appended to the training file.

SGS - Orlando Data Integrity and Ethical Conduct Agreement. All employees are required to sign a Data Integrity and Ethical Conduct Agreement annually – See Appendix VI This document is archived in individual training files, which are retained for duration of employment.

Data Integrity Monitoring. Several documented procedures are employed for performing data integrity monitoring. These include regular data review procedures by supervisory and management staff (Section 12.7), supervisory review and approval of manual integrations and periodic reviews of data audit trails from the LIMS and all computer controlled analysis.

Data Review. All data produced by the laboratory undergoes several levels of review, which includes two levels of management review. Detected data anomalies that appear to be related to data integrity issues are isolated for further investigation. The investigation is conducted following the procedures described in this section.

Manual Peak Integration Review and Approval. Routine data review procedures for all chromatographic processes includes a review of all manual chromatographic peak integrations. This review is performed by the management staff and consists of a review of the machine integration compared to the manual integration. Manual integrations, which have been performed in accordance with SGS - Orlando's manual peak integration procedures are approved for further processing and release. Manual integrations which are not performed to SGS - Orlando's specifications are set aside for corrective action, which may include analyst retraining or further investigation as necessary.

Data Audit Trail Review. Data integrity audits are comprehensive data package audits that include a review of raw data, process logbooks, processed data reports and data audit trails from individual instruments and LIMS. Data audit trails, which record all electronic data activities, are available for the majority of computerized methodology and the laboratory information management system (LIMS). These audit trails are periodically reviewed to determine if interventions performed by technical staff constitute an appropriate action. The review is performed on a recently completed job and includes interviews with the staff that performed the analysis. Findings indicative of inappropriate interventions or data integrity issues are investigated to determine the cause and the extent of the anomaly.

Confidential Reporting Of Data Integrity Issues. Data integrity concerns may be raised by any individual to their supervisor. Employees with data integrity concerns should always discuss those concerns with their immediate supervisors as a first step unless the employee is concerned with the confidentiality of disclosing data integrity issues or is uncomfortable discussing the issue with their immediate supervisors. The supervisor makes an initial assessment of the situation to determine if the concern is related to a data integrity violation. Those issues that appear to be violations are documented by the supervisor and referred to the QA Officer (local) for investigation.

Documented procedures for the confidential reporting of data integrity issues in the laboratory are part of the data integrity policy. These procedures assure that laboratory staff can privately discuss ethical issues or report items of ethical concern without fears of repercussions with senior staff.

Employees with data integrity concerns that they consider to be confidential are directed to the Human Resources Specialist in Dayton, New Jersey. The HR Specialist acts as a conduit to arrange a private discussion between the employee and the Corporate QA Director or a local QA Officer.

During the employee - QA discussion, the QA representative evaluates the situation presented by the employee to determine if the issue is a data integrity concern or a legitimate practice. If the practice is legitimate, the QA representative clarifies the process for the employee to assure understanding. If the situation appears to be a data integrity concern, the QA representative initiates a Data Integrity Investigation following the procedures specified in SOPs QA038-QA041.

Data Integrity Investigations. Follow-up investigations are conducted for all reported instances of ethical concern related to data integrity. Investigations are performed in a confidential manner by senior management according to a documented procedure. The outcome of the investigation is documented and reported to the VP of EHS who has the ultimate responsibility for determining the final course of action in the matter. Investigation documentation includes corrective action records, client notification information and disciplinary action outcomes, which is archived for a period of five years.

The investigations are conducted by the senior staff and supervisory personnel from the affected area. The investigation team includes the Laboratory Director and the Quality Assurance Officer. Investigations are conducted in a confidential manner until it is completed and resolved.

The investigation includes a review of the primary information in question by the investigations team. The team performs a review of associated data and similar historical data to determine if patterns exist. Interviews are conducted with key staff to determine the reasons for the observed practices.

Following data compilation, the investigations team reviews all information to formulate a consensus conclusion. The investigation results are documented along with the recommended course of action.

Corrective Action, Client Notification & Discipline. Investigations that reveal systematic data integrity issues will go through corrective action for resolution and disposition (Section 13). If the investigation indicates that an impact to data has occurred and the defective data has been released to clients, client notification procedures will be initiated following the steps in Section 17.6.

In all cases of data integrity violations, some level of disciplinary action will be conducted on the responsible individual. The level of discipline will be consistent with the violation and may range from retraining and/or verbal reprimand to termination.

JOB DESCRIPTIONS OF KEY STAFF

***Requirement*:** Descriptions of key positions within the organization must be defined to ensure that clients and staff understand duties and the responsibilities of the management staff and the reporting relationships between positions.

VP of EHS. Responsible for all company EHS division operations and business activities. Establishes the company mission and objectives in response to business needs. Direct supervision of the Vice President of Operations, each laboratory director, client services, management information systems, and Corporate quality assurance.

Laboratory Director/General Manager. Reports to the VP of EHS. Establishes regional laboratory operations strategy and business development. Authorized to enter into contractual agreements on Company's behalf. Directs the day-to-day operations of entire laboratory, direct supervision of organic chemistry, inorganic chemistry, field services, and sample management. Oversees daily work schedule as developed by respective departments. Supervises method implementation. Responsible for following Quality Program requirements. Maintains laboratory instrumentation in an operable condition.

Director, Quality Assurance. Reports to the VP of EHS. Establishes the company quality agenda, develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities monitors the quality system and provides quality system feedback to management to be used for process improvement.

Vice President, Information Technologies Reports to the VP of EHS. Develops the MIS software and hardware agenda. Provides system strategies to compliment company objectives. Maintains all software and hardware used for data handling.

Client Services, Sales, Account Manager(s). Reports to the VP of EHS. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Quality Assurance Officer *(on location)*. Reports to the Corporate QA Director. Develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities, monitors the quality system, and provides quality system feedback to management to be used for process improvement. In the event of prolonged absence QAO also designated a Deputy Technical Director, unless otherwise specified by internal memo from Laboratory Director.

Manager Client Services *(on location)*. Reports to the Laboratory Director. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Technical Director (*on Location***)**. Laboratory Director/General Manager is designated Technical Director. Establishes laboratory operations strategy. Direct supervision of organic chemistry and inorganic chemistry. Directs the operations, preparation and instrumental analysis. Responsible for following Quality Program requirements. .

Supervisors, Shipping and Receiving Departments. Reports to the Laboratory Director. Develops, maintains and executes all procedures required for transport and receipt of samples, verification of preservation, and chain of custody documentation. Responsible for maintaining and documenting secure storage, delivery of samples to laboratory units on request, and disposal following completion of all analytical procedures.

Supervisor, Inorganics. Reports to the Laboratory Director. Directs the operations of the General Chemistry and Metals group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for Inorganics parameters using valid, documented methodology. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

requirements. Responsible for following Quality Program requirements

Supervisor, Organic Preparation. Reports to the Laboratory Director. Directs the operations of the sample preparation group. Establishes and executes daily work schedule. Supervises method implementation, and application. Supervises the preparation of samples for organic compounds using valid, documented methodology. Documents all procedures and data production activities. Maintains laboratory equipment in an operable condition. Reviews records for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

Volatile and Semivolatie Supervisors, Organics. Reports to the Laboratory Director. Directs the operations of the respective organics group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for organic compounds using valid, documented methodology. Documents all procedures and data production activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements

Report Generation Supervisor. Reports to Laboratory Director. Oversees report generation and fulfillment of client specifications as applied to data deliverables. Responsible for data delivery in timely manner.

Detailed Job descriptions of lab personnel are found in training folders

4.2 ***Employee Screening, Orientation, and Training***.

All potential laboratory employees are screened and interviewed by human resources and technical staff prior to their hire. The pre-screen process includes a review of their qualifications including education, training and work experience to verify that they have adequate skills to perform the tasks of the job. Minimum qualifications for non-technical personnel require High School diploma (couriers also must posses clean driving record), technical personnel must also demonstrate basic laboratory experience, such as balance and syringe use, aseptic practices, etc. College-level science coursework is favored.

Newly hired employees receive orientation training beginning the first day of employment by the Company. Orientation training consists of initial health and safety training and a detailed review of the personal protection policies, technical ethics and data integrity procedures training (for detailed description refer to Sec. 3.3) and quality assurance program training (including Company's goals, objectives, mission, and vision).

All technical staff receives training to develop and demonstrate proficiency for the methods they perform. New analysts work under supervision until the supervisory staff is satisfied that a thorough understanding of the method is apparent. Organics/Inorganics analysts are required to demonstrate method proficiency through a precision and accuracy study (Demonstration of Capability). Data from the study is reviewed by appropriate technical supervisor and compared to method acceptance limits. If the data is unacceptable, additional training is required. The analyst must also demonstrate the ability to produce acceptable data through the analysis of an independently prepared proficiency sample.

Proficiency is demonstrated annually. Data from initial and continuing proficiency demonstration is archived in the individual's training folder. In the instance where analyte can not be spiked in the clean matrix, such as TSS or pH, the results of an external Performance Evaluation (PE) sample may be used to document analyst's proficiency.

Minimum training required for administrative staff consists of laboratory safety and ethical conduct.

4.3 ***Training Documentation***. The QA Officer prepares a training file for every new employee. All information related to qualifications, experience, external training courses, and education are placed into the file. Verification documentation for orientation, health & safety, quality assurance, and ethics training is also included in the file.

Additional training documentation is added to the file as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluation study data and notes and attendance lists from group training sessions.

The Quality Assurance Department also maintains the employee training database – SGS - Orlando University. This database is a comprehensive inventory of training documentation for each individual employee. The database enables supervisors to obtain current status information on training data for individual employees on a job specific basis. It also enables the management staff to identify training documentation in need of completion.

Employee specific database records are created by QA Staff on the date of hire. Reports are produced which summarize the qualifications of individual employees or departments.

SIGNATORY APPROVALS

Requirement: Procedures are required for establishing the traceability of data and documents. The procedure consists of a signature hierarchy, indicating levels of authorization for signature approvals of data and information within the organization. Signature authority is granted for approval of specific actions based on positional hierarchy within the organization and knowledge of the operation that requires signature approval. A log of signatures and initials of all employees is maintained for cross-referencing purposes.

Signature Hierarchy.

Vice-President of EHS North America. Authorization for contracts and binding agreements with outside parties up to $150,000. Contract signature authority in excess of $150,000 resides with Executive VP of EHS Global in Geneva, Switzerland.

Laboratory Director/General Manager (however named). Authorization for binding agreements with outside parties up to $25,000. General Manager may also sign non-binding agreements such as work authorizations, purchase orders, confidentiality agreements, etc. Approval of final reports and quality assurance policy. Approval of project-specific QAPs~~.~~ Review and approval of technical and quality systems policies (LQSM). In the event of prolonged absence refer to list of approved deputies – sec 2.2.

Technical Director: Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs. Review and approval of technical and quality systems policies (LQSM). In the event of prolonged absence refer to list of approved deputies – sec 2.2.

Director, Quality Assurance. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers.

Quality Assurance Officer (on location). Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. In the event of prolonged absence refer to list or appointed deputies – see sec. 2.2.

Manager, Sample Management. Initiation of laboratory sample custody and acceptance of all samples. Approval of department policies and procedures. Department specific supplies purchase. Waste manifesting and disposal.

Project Manager, Client Services. QAP and sampling and analysis plan approval. Project specific contracts, pricing, and price modification agreements. Approval and acceptance of incoming work, Client services policy.

Supervisors, Technical Departments. Data review and approval, department specific supplies purchase. Technical approval of SOPs.

Signature Requirements. All laboratory activities related to sample custody and generation or release of data must be approved using either initials or signatures. The individual, who applies his signature or initial to an activity or document, is authorized to do so within the limits assigned to them by their supervisor. All signatures and initials must be applied in a readable format that can be cross-referenced to the signatures and initials log if necessary.

Signature and Initials Log. The QA Officer maintains a signature and initials log. New Employee signatures and initials are appended to the log on the first day of employment. Electronic signatures are appended to Electronic signature log. Signature of individuals no longer employed by the company are retained**.**

DOCUMENTATION and DOCUMENT CONTROL

Requirement: Document control policies have been established which specify that any document used as an information source or for recording analytical or quality control information must be managed using defined document control procedures. Accordingly, policies and procedures required for the control, protection, and storage of any information related to the production of analytical data and the operation of the quality system to assure its integrity and traceability have been established and implemented in the laboratory. The system contains sufficient controls for managing, archiving and reconstructing all process steps, which contributed to the generation of an analytical test result. Using this system, an audit trail for reported data can be produced, establishing complete traceability for the result.

> **Administrative Records.** The Quality Assurance Officer manages Administrative (non-analytical) records. These records consist of electronic documents that are retained in a limited access electronic directory, which are released to the technical staff upon specific request.

Form Generation & Control. The Quality Assurance Officer approves all forms used as either stand-alone documents or in logbooks to ensure their traceability. Forms are generated as computer files only and maintained in a limited access master directory. Access to the electronic forms and applications is granted to QA Officer, Laboratory Manager and Technical Director(s) (local and regional). Approved forms must display the date of current revision and initials of person who revised the form. Modifications to existing forms are approved by QA, obsolete forms moved to archive directory and retained for minimum of five years.

New forms must include SGS - Orlando identification and appropriate spaces for signatures of approvals and dates. Further design specifications are the responsibility of the originating department.

Technical staff is required to complete all forms to the maximum extent possible. If information for a specific item is unavailable, the analyst is required to cross out the information block. The staff is also required to cross out the uncompleted portions of a logbook or logbook form if the day's analysis does not fill the entire page of the form.

Logbook Control. All laboratory logbooks are controlled documents that are comprised of approved forms used to document specific processes. Logbook control is maintained by QA staff.

New logs are numbered and issued to a specific individual who is assigned responsibility for the log. Supervisor performs periodical review of the logbooks. Old logs are returned to QA for entry into the document archive system where they are retained for minimum of five (5) years. Laboratory staff may hold a maximum of two consecutively dated logbooks of the same type in the laboratory, not including the most recently issued book to simplify review of recently completed analysis.

__Controlled Documents.__ Key laboratory documents are designated for controlled document status to assure that identities of individuals receiving copies and the number of copies that have been distributed are known. Controlled status simplifies document updates and **retrieval** of outdated documents. Control is maintained through a document numbering procedure and document control logbook designating the individual receiving the controlled document. Document control is also maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory.

Quality Systems Manual (QSM). QSMs distributed to outside entities are considered tracked documents – since there is no possibility of collecting them back and ensuring that current revision is in use. These situations include bid submissions, client requests, etc. These copies can be watermarked as “Uncontrolled Documents”. The date of distribution, and identity of the individual receiving the document are captured in the digital communications.

Standard Operating Procedures (SOPs). SOPs are maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory. Official documents are printed and placed into the appropriate laboratory section as follows:

Sample Management: One copy for the sample receiving file, copy may be electronic
Bottle preparation area – One copy for shipping area, copy may be electronic
Organics Laboratories: One for each affected laboratory area. Copy may be electronic.
Inorganics Laboratories: One for each affected laboratory area. Copy may be electronic.

The original, signed copy of the SOP is maintained in the master SOP binder by the QA staff.

Documents are controlled using an “Official Copy” stamp in red ink. Additional copies could be issued to individuals for training purposes. Distribution is documented on SOP cover page. Superseded copies collection is conducted accordingly to cover page distribution list.

SOPs distributed to clients as part of bid submission, pre-audit evaluation, etc. can be watermarked as “Proprietary Information”.

Quick reference cards: These documents are compiled for lab staff convenience and are based on current SOP revision and/or recent regulatory updates. These one- or two-sided documents are footnoted with reference to SOP/regulatory standard, stamped with “Official Copy” stamp in red ink and laminated for durability. ***Use of these quick references does not substitute reading and acknowledging the parent SOP***.

Operators' Manuals are considered controlled documents and stored in appropriate departments. QA staff maintains current listing of Operator's manuals.

Technical Records. All records related to the analysis of samples and the production of analytical results are archived in secure document storage or on electronic media and contain sufficient detail to produce an audit trail, which re-creates the analytical result. These records include information related to the original client request, bottle order, sample login and custody, storage, sample preparation, analysis, data review and data reporting.

Records that cannot be maintained on electronic media are considered irretrievable records, segregated into separate secured storage and access controlled with access log maintained by QA Staff. Examples of such records are employee training files, obsolete SOPs and acknowledgement form originals, training files, logbooks, etc.

Each department involved in this process maintains controlled documents, which enable them to maintain records of critical information relevant to their department's process.

Quality Assurance Directory. All Quality Assurance documentation and quality control limit data is stored in a restricted QA directory on the network server. The directory has been designated as read only. The QA staff, technical director and the laboratory manager have write capability in this directory. Information on this directory is backed-up weekly.

This directory contains all current and archived Quality System Manuals, SOPs, control limits, MDL studies, precision and accuracy data, internal and external audit reports, official forms, Health and Safety materials, PT scores, State Certifications and metrics calibration information.

Analytical Records. All data related to the analysis of field samples are retained as either paper or electronic records that can be retrieved to compile a traceable audit trail for any reported result. All information is linked to the client job and sample number, which serves as a reference for all sample related information tracking.

Critical times in the life of the sample from collection through analysis to disposal are documented. This includes date and time of collection, receipt by the laboratory, preparation times and dates, analysis times and dates and data reporting information. Analysis times are calculated in hours for methods where holding time is specified in hours (≤72 hours).

Sample preparation information is recorded in a separate controlled logbook or on controlled forms in three-ring binder. It includes sample identification numbers, types of analysis, preparation and cleanup methods, sample weights and volumes, reagent lot numbers and volumes and any other information pertinent to the preparation procedure.

Information related to the identification of the instrument used for analysis is permanently attached to the electronic record. The record includes an electronic data file that indicates all instrument conditions employed for the analysis, including the type of analysis conducted. The analyst's identification is electronically attached to the record. The instrument tuning and calibration data is electronically linked to the sample or linked though paper logs, which were used in the documentation of the analysis. Quality control and performance criteria are permanently linked to the paper archive or electronic file.

Paper records for the identity, receipt, preparation and evaluation of all standards and reagents used in the analysis are documented in prepared records and maintained in controlled documents or files. Lot number information linking these materials to the analysis performed is recorded in the logbooks associated with the samples in which they were used.

Manual calculations or peak integrations that were performed during the data review are retained as paper or electronically generated PDF documents and included as part of the electronic archive. Signatures for data review are retained on paper or as electronic stamps on PDF versions of the paper record for the permanent electronic file.

Confidential Business Information (CBI). Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between SGS - Orlando and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only.

Software Change Documentation & Control. Changes to software are documented as text within the code of the program undergoing change. Documentation includes a description of the change, reason for change and the date the change was placed into effect. Documentation indicating the adequacy of the change is prepared following the evaluation by the user who requested the change.

Report and Data Archiving. SGS - Orlando maintains electronic image file copies of original reports in archive for a minimum period of five (5) years. After five years, the files are automatically discarded unless contractual arrangements exist which dictate different requirements. Client specific data retention practices are employed for government organizations such as the Department of Defense Agencies and MA DEP that require a retention period of ten (10) years, as well as commercial clients upon contractual requirements agreement.

Complete date and time stamped client reports are generated from LIMS using the source documents archived on Document server. These source documents are maintained on document server and backed up to removable primary and clone hard drives. SGS - Orlando archives the original report (organized by job number) and the organic and inorganic support data. Organic support data is archived according to instrument batch numbers and datafile. All organics data is backed up to an archive drive via Baculla backup software and/or AccuBack backup software. Data from the archive drive is then written to removable hard drives at periodic intervals. Drives are cloned for an offsite archival.

Wet chemistry support data is archived by analytical batch (GN…). Metals support data is archived by instrument batch (MA…). Metals digestion data is archived as digestion logbooks. Additionally all Wet chemistry and Metals data is scanned to PDF and archived electronically.

The reports generation group electronically scans completed reports and stores them by job number on the document server. The document server is backed up daily to a removable hard drive. Copies of these files remain active on the document server for easy review access. The removable hard drives remain in secure storage for the remainder of the archive period.

Training. Ongoing training ensures competence of all relevant personnel. At the minimum personnel should possess knowledge of the technology used in the testing, general requirements expressed in legislature and industry standards, and understand the significance of deviations with regard to approved procedures. The company maintains a training record for all employees that documents that they have received instruction on administrative and technical tasks that are required for the job they perform. Training records for individuals employed by the company are retained for a period of five years following their termination of employment.

Training File Origination. The Quality Assurance Officer (QAO) initiates training files. Quality Assurance officer retains the responsibility for the maintenance and tracking of all training related documentation in the file. The file is started on the first day of employment. Information required for the file includes a copy of the individual's most current resume, detailing work experience and a copy of any college diplomas or transcript(s), if applicable. Information added on the first day includes documentation of health and safety training and a signed Ethics and Data Integrity agreement. Classroom content is standardized across entire SGS - Orlando network and administered using SGS - Orlando University database. Safety and Ethics training constitute minimal necessary training for Project Management and Administrative staff. Analyst training documentation, training requirements, analyst proficiency information and other training related support documentation is tracked using a customized database applications. Database extracts provide an itemized listing of specific training requirements by job function. Training status summaries for individual analysts portray dates of completion for job specific training requirements.

Technical Training. The supervisor of each new employee is responsible for developing a training plan for each new employee. The supervisor updates the outline, adding signatures and dates as training elements are completed at regular frequency. Supporting documentation, such as precision and accuracy studies, which demonstrate analyst capability for a specific test, are added as completed. When analyte can not be spiked, such as pH or TSS, external PE sample is purchased and analyzed. Where no external PE sample is available, sample duplicates must be successfully analyzed. Method review records are retained where analysis of duplicates is not possible. Employees and supervisors verify documentation of understanding (DOU) for all assigned standard operating procedures in the training files. Certificates or diplomas for any off-site training are added to the file.

7.0 REFERENCE STANDARD TRACEABILITY

Requirement: Documented procedures, which establish traceability between any measured value and a national reference standard, must be in place in the laboratory. All metric measurements must be traceable to NIST reference weights or thermometers that are calibrated on a regular schedule. All chemicals used for calibration of a quantitative process must be traceable to an NIST reference that is documented by the vendor using a certificate of traceability. The laboratory maintains a documentation system that establishes the traceability links. The procedures for verifying and documenting traceability must be documented in standard operating procedures.

Traceability of Metric Measurements - Thermometers. SGS – Orlando uses NIST-traceable thermometers to calibrate commercially purchased working laboratory thermometers prior to their use in the laboratory and annually thereafter for liquid in glass thermometers or quarterly for electronic temperature measuring devices. If necessary, these working thermometers are assigned correction factors that are determined during their calibration using an NIST-traceable thermometer as the standard. The correction factor is documented in a thermometer log and on a tag attached to the working thermometer. Both original observation and corrected measurement are recorded in the temperature log. The NIST-traceable reference thermometer is checked for accuracy by an outside vendor minimum every five (5) years following the specifications for NIST-traceable thermometer calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Currently the NIST thermometer is verified by outside vendor on triennial basis due to contract-specific requirements. Calibration log and Certificate(s) of calibration are maintained on file with QAO.

Traceability of Metric Measurements – Calibration Weights. SGS – Orlando uses calibrated weights, which are traceable to NIST standard weights to calibrate all balances used in the laboratory. Balances must be calibrated to specific tolerances within the intended use range of the balance. Calibration checks are required on each day of use. If the tolerance criteria are not achieved, corrective action specified in the balance calibration SOP must be applied before the balance can be used for laboratory measurements. All weights are recalibrated by outside vendor every five years following the specifications for weight calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Certificate(s) of calibration are maintained on file with QAO. Balances are inspected and maintained by professional service technicians annually. Certificate(s) of inspection are maintained with QAO.

Traceability of Chemical Standards and Reagents. All chemicals and reagents, purchased as reference standards for use in method calibration must establish traceability to NIST referenced material through a traceability certificate (Certificate of Analysis, CoA). Process links are established that enable a calibration standard solution to be traced to its NIST reference certificate. Solvents, acids and other supplies are being tested to verify their suitability for the analytical process.

Assignment Of Reagent and Standard Expiration Dates. Expiration date information for all purchased standards and reagents is provided to SGS – Orlando with all prepared standard solutions and unstable reagents as a condition of purchase. Neat materials and inorganic reagents are not required to be purchased with expiration dates. Certified prepared solutions are labeled with the expiration date provided by the manufacturer. In-house prepared solutions are assigned expiration dates that are consistent with the method that employs their use unless documented experience indicates that an alternate date can be applied. If alternate expiration dates are employed, their use is documented in the method SOP. Expiration dates for prepared inorganic reagents, which have not exhibited instability, are established at two years form the date of preparation for tracking purposes. All containers shall be labeled with the date of preparation and expiration date clearly indicated.

The earliest expiration date is always the limiting date for assigning expiration dates to prepared solutions. Expiration dates that are later than the expiration date of any derivative solution or material are prohibited.

Documentation of Traceability. Traceability information is documented in individual logbooks designated for the measurement process in use. The QA Officer maintains calibration documentation for metric references in pertinent folders and logbooks.

Balance calibration verification is documented in logbooks that are assigned to each balance. The individual conducting the verification is required to initial and date all calibration activities. Any defects that occur during verification are also documented along with the corrective action applied and a demonstration of return to control. Annual service and calibration reports and certificates retained on file with QA staff.

Temperature control is documented in logbooks assigned to the equipment being monitored. A verified (see 7.1) thermometer is assigned to each individual item. Measurements are recorded along with date and initials of the individual conducting the measurement on a daily or as used basis. Corrective action, if required, is also documented including the demonstration of return to control.

Initial traceability of chemical standards and reagents is documented via a vendor-supplied certificate (see also 7.3) that includes lot number and expiration date information. Solutions prepared using the vendor supplied chemical standards are documented in logbooks assigned to specific analytical processes. Alternatively, documentation may be entered into the electronic standards and reagent tracking log The documentation includes links to the vendors lot number, an internal lot number, dates of preparation, and the preparer’s initials. Standards received without certificate of analysis can not be used for calibration or calibration verification and are rejected.

Supervisors conduct regular reviews of logbooks, which are verified using a word rev’d”, signature and date. QA Staff monitors the process and documents it in the same manner.

TEST PROCEDURES, METHOD REFERENCES, AND REGULATORY PROGRAMS

Requirements: The laboratory must use client specified or regulatory agency approved methods for the analysis of environmental samples. The laboratory maintains a list of active methods, which specifies the type of analysis performed, and cross-references the methods to applicable environmental regulation. Routine procedures used by the laboratory for the execution of a method must be documented in a standard operating procedure. Method performance and sensitivity must be demonstrated annually where required. Defined procedures for the use of method sensitivity for data reporting purposes must be established by the Director of Quality Assurance and used consistently for all data reporting purposes.

Method Selection. SGS - Orlando employs methods for environmental sample analysis that are consistent with the client's application, which are appropriate and applicable to the project objectives. SGS – Orlando informs the client if the method proposed is inappropriate or outdated and suggests alternative approaches.

SGS - Orlando employs documented, validated regulatory methods in the absence of a client specification and informs the client of the method selected. These methods are available to the client and other parties as determined by the client. Documented and validated in-house methods may be applied if they are appropriate to the project. The client is informed of the method selection.

Method Validation. Standard methods from regulatory sources are primarily used for all analysis. Standard methods do not require validation by the laboratory. Non-standard, in-house methods are validated prior to use. Validation is also performed for standard methods applied outside their intended scope of use. Validation is dependent upon the method application and may include analysis of quality control samples to develop precision and accuracy information for the intended use. A final method validation report is generated, which includes all data in the validation study. A statement of adequacy and/or equivalency is included in the report. A copy of the report is archived in the quality assurance directory of the company server.

Non-standard methods are validated prior to use. This includes the validation of modified standard methods to demonstrate comparability with existing methods. Demonstrations and validations are performed and documented prior to incorporating technological enhancements and non-standard methods into existing laboratory methods used for general applications. The demonstration includes method specific requirements for assuring that significant performance differences do not occur when the enhancement is incorporated into the method. Validation is dependent upon method application and may include the analysis of quality control samples to develop precision and accuracy information for intended use.

The study procedures and specifications for demonstrating validation include comparable method sensitivity, calibration response, method precision, method accuracy and field sample consistency for several classes of analytical methods are detailed in this document. These procedures and specifications may vary depending upon the method and the modification.

Standard Operating Procedures. Standard operating procedures (SOP) are prepared for routine methods executed by the laboratory and processes related to sample or data handling. The procedures describe the process steps in sufficient detail to enable an individual, who is unfamiliar with the procedure to execute it successfully. SOPs are reviewed annually and edited if necessary. SOPs can be edited on a more frequent basis if systematic errors dictate a need for process change or the originating regulatory agency promulgates a new version of the method. Procedural modifications are indicated using a revision number. SOPs are available for client review at the SGS - Orlando facility upon request.

Method Detection Limit Determination and verification. Continuous method detection limit (MDL) studies are performed as appropriate for routine methods used in the laboratory. MDL studies are also performed when there is a change to the method that affects how the method is performed or when an instrumentation change that impacts sensitivity occurs. The procedure used for determining MDLs is described in 40 CFR, Part 136, Appendix B, revision 2, December 2016. Studies are performed for each method on water, soil and air matrices for every instrument that is used to perform the method. MDLs are established at the instrument level. The highest MDL of the pooled instrument data is used to establish a laboratory MDL. MDLs are experimentally verified through the analysis of spiked quality control samples at 2-3 times the concentration of the experimental MDL, or 1-4 times for multicomponent methods. The verification is performed on every instrument used to perform the analysis. The quality assurance staff manages the continuous MDL determination process and is responsible for retaining MDL data on file. Approved MDLs are appended to the LIMS and used for data reporting purposes. MDL values are used as DL values for DOD projects and verification spiking concentrations are listed as LOD values.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 5-series,Volume 1, Module 4, 1.5.2.1.g)

Method Reporting Limit. The method reporting limit is established at the lowest concentration calibration standard in the calibration curve. The low calibration standard is selected by department managers as the lowest concentration standard that can be used while continuing to meet the calibration linearity criteria of the method being used. The validity of the Method Reporting Limits is confirmed via analysis of a spiked quality control sample at 1 – 2x Method reporting limit concentration. RL values are referred to as LOQ for DOD projects.

By definition, detected analytes at concentrations below the low calibration standard cannot be accurately quantitated and must be qualified accordingly.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 5.0 and 5.1,Volume 1, Module 4, 1.5.2.2.e).

Reporting of Quantitative Data. Analytical data for all methods is reported without qualification to the reporting limit established for each method. Data may be reported to MDL depending upon the client's requirements provided that all qualitative identification criteria for the parameter have been satisfied. All parameters reported at concentrations between the reporting limit and MDL are qualified as an estimated concentration.

Measured concentrations of detected analytes that exceed the upper limit of the calibration range are either diluted into the range and reanalyzed or qualified as an estimated value. The only exception to this applies to ICP and ICP/MS analysis, which can be reported to the upper limit of the experimentally determined linear range without qualification.

Estimated Uncertainty. A statement of the estimated uncertainty of an analytical measurement accompanies the test result when required. Estimated uncertainty is derived from the performance limits established for spiked samples of similar matrices. The degree of uncertainty is derived from the negative or positive bias for spiked samples accompanying a specific parameter. When the uncertainty estimate is applied to a measured value, the possible quantitative range for that specific parameter at that measured concentration is defined. Well recognized regulatory methods that specify values for the major sources of uncertainty and specify the data reporting format do not require a further estimate of uncertainty.

Precision and Accuracy Studies. Annual precision and accuracy (P&A) studies, which demonstrate the laboratories ability to generate acceptable date, are performed for all routine methods used in the laboratory. The procedure used for generating P&A data is referenced in the majority of the regulatory methodology in use. The procedure requires quadruplicate analysis of a sample spiked with target analytes at a concentration in the working range of the method. This data may be compiled from a series of existing blank spikes or laboratory control samples. Accuracy (percent recovery) of the replicate analysis is averaged and compared to established method performance limits. Values within method limits indicate an acceptable performance demonstration. (See also Sec 4, Training, Demonstration of capability)

Method Sources, References and Update Mechanism. The Quality Assurance Staff maintains a list of active methods used for the analysis of samples. This list includes valid method references such as EPA, American Society of Testing and Materials (ASTM) or Standard Methods designations and the current version and version date.

Updated versions of approved reference methodology are placed into use as changes occur. The Quality Assurance Director informs operations management of changes in method versions as they occur. The operations management staff selects an implementation date. The operations staff is responsible for completing all method requirements prior to the implementation date. This includes modification to SOPs, completion of MDL and precision and accuracy studies and staff training. Documentation of these activities is provided to the QA staff who retains this information on file. The updated method is placed into service on the implementation date and the old version is de-activated.

Multiple versions of selected methods may remain in use to satisfy client specific needs. In these situations, the default method version becomes the most recent version. Client specific needs are communicated to the laboratory staff using method specific analytical codes, which clearly depict the version to be used. The old method version is maintained as an active method until the specified client no longer requires the use of the older version.

SGS - Orlando will not use methodology that represents significant departures from the reference method ***unless specifically directed by the client***. In cases where clients direct the laboratory to use a method modification that represents a significant departure from the reference method, the request will be documented in the project file. The LQSM lists active methods used for the analysis of samples in Table 8.1. This list includes valid method references from sources such as USEPA, ASTM or Standard Methods designations and the current version and version date.

Analytical Capabilities. Appendix II provides a detailed listing of the methodology employed for the analysis of test samples.

SAMPLE MANAGEMENT, LOGIN, CUSTODY, STORAGE AND DISPOSAL

Requirement: A system to ensure that client supplied product is adequately evaluated, acknowledged, and secured upon delivery to the laboratory must be practiced by the laboratory. The system must assure that chain of custody is maintained and that sample receipt conditions and preservation status are documented and communicated to the client and internal staff. The login procedure must assign, document, and map the specifications for the analysis of each unique sample to assure that the requested analysis is performed on the correct sample and enables the sample to be tracked throughout the laboratory analytical cycle. The system must include procedures for reconciling defects in sample condition or client provided data, which occur at sample arrival. The system must specify the procedures for proper sample storage, transfer to the laboratory, and disposal after analysis. The system must be documented in a standard operating procedure.

Order Receipt and Entry. New orders are initiated and processed by the client services group (See Chapter 14, Procedures for Executing Client Specifications). The new order procedure includes mechanisms for providing sampling containers to clients. These containers must meet the size, cleanliness, and preservation specifications for the analysis to be performed.

For new orders, the project manager prepares a bottle request form, which is submitted to sample management department. This form provides critical project details to the sample management staff, which are used to prepare and assemble the sample bottles for shipment to the client prior to sampling.

The bottle order is assembled using bottles that meet USEPA specifications for contaminant-free sample containers. SGS - Orlando checks all sample containers for cleanliness. Data are reviewed by both the analyst and sample management technician. Results of bottle analyses are retained for minimum of 5 years.

All preservative solutions are prepared in the laboratory and are checked to assure that they are free of contamination from analytes of interest before being released for use. Sample management department retains a copy of the documentation of in-house contamination checks.

Reagent water for trip and field blanks is poured into appropriately labeled containers. Sample bottleware is labeled with durable labels printed on waterproof printing medium with indelible laser or heat transfer printer ink. All bottles are packed into ice chests with blank chain of custody forms and the original bottle order form. Completed bottle orders are delivered to clients using SGS - Orlando couriers or commercial carriers for use in field sample collection.

Sample Receipt and Custody. Samples are delivered to the laboratory using a variety of mechanisms including SGS - Orlando couriers, commercial shippers, and client self-delivery. Documented procedures are followed for arriving samples to assure that custody and integrity are maintained and that handling and preservation requirements are documented and continued.

Sample custody documentation is initiated when the individual collecting the sample collects field samples. Custody documentation includes all information necessary to provide an unambiguous record of sample collection, sample identification, and sample collection chronology. Initial custody documentation employs either SGS - Orlando or client generated custody forms.

SGS - Orlando generates a Sample Receipt Confirmation form in situations where the individuals who collected the sample did not generate custody documentation in the field. SGS - Orlando Project Manager then contacts the client for the CoC information to be faxed or e-mailed from the client to the lab.

SGS - Orlando defines sample custody as follows:

- The sample is in the actual custody or possession of the assigned responsible person,

- The sample is in a secure area.

The SGS -Orlando facility is defined as a secure facility. Perimeter security has been established, which limits access to authorized individuals only. Visitors enter the facility through the building lobby and must register with the receptionist prior to entering controlled areas. While in the facility, visitors must be accompanied by their hosts at all times. After hours, building access is controlled using a computerized pass-key reader system. This system limits building access to individuals with a pre-assigned authorization status. After hours visitors are not authorized to be in the building. Clients delivering samples after hours must make advanced arrangements through client services and sample management to assure that staff is available to take delivery and maintain custody.

Upon arrival at SGS - Orlando, the sample custodian reviews the chain of custody and generates Sample Receipt Confirmation form for the samples received to verify that the information on the form corresponds with the samples delivered. This includes verification that all listed samples are present and properly labeled, checks to verify that samples were transported and received at the required temperature, verification that the sample was received in proper containers, verification that sufficient volume is available to conduct the requested analysis, and a check of individual sample containers to verify test specific preservation requirements including the absence of headspace for volatile compound analysis.

Sample conditions and other observations are documented on the Sample Receipt Confirmation form by the sample custodian prior to completing acceptance of custody. The sample custodian accepts sample custody upon verification that the custody document is correct. Discrepancies or non-compliant situations are documented, flagged and communicated to the SGS - Orlando project manager, who contacts the client for resolution. The resolution is documented and communicated to sample management for execution.

Laboratory preservation of Improperly preserved field samples. SGS - Orlando extends every effort to preserve samples which were received without proper field preservation.

Field/Equipment negative controls also receive the same amount of preservation as incorrectly preserved samples, and record made in the preservation logbook.

Sample Tracking Via Status Change. An automated, electronic LIMS procedure records sample exchange transactions between departments and changes in analytical status. This system tracks all preparation, analytical, and data reporting procedures to which a sample is subjected while in the possession of the laboratory. Each individual receiving samples must acknowledge the change in custody and operational status in the LIMS. This step is required to maintain an accurate electronic record of sample status, dates of analytical activity, and custody throughout the laboratory.

Sample tracking is initiated at login where all chronological information related to sample collection dates and holding times are entered into the LIMS. This information is entered on an individual sample basis

Sample Acceptance Policy. Incoming samples must satisfy SGS - Orlando sample acceptance criteria before being logged into the system. Sample acceptance is based on the premise that clients have exercised proper protocols for sample collection. This includes sufficient volume, proper chemical preservation, temperature preservation, sample container sealing and labeling, and appropriate shipping container packing.

The sample management staff will make every attempt to preserve improperly preserved samples upon arrival. However, if preservation is not possible, the samples may be refused unless the client authorizes analysis. No samples will be accepted if holding times have been exceeded or will be exceeded before analysis can take place unless the client authorizes analysis.

Sample acceptance criteria include proper custody and sample labeling documentation. Proper custody documentation includes an entry for all physical samples delivered to the laboratory with an identification code that matches the sample bottle and a date and signature of the individual who collected the sample and delivered them to the laboratory. Labeling is done using durable waterproof labels printed with indelible heat-transfer ink.

SGS - Orlando reserves the right to refuse any sample which in its sole and absolute discretion and judgement is hazardous, toxic and poses or may pose a health, safety or environmental risk during handling or processing. The company will not accept samples for analysis using methodology that is not performed by the laboratory or for methods that lab does not hold valid accreditation unless arrangements have been made to have the analysis conducted by a qualified subcontractor.

Assignment of Unique Sample Identification Codes. Unique identification codes must be assigned to each sample bottle to assure traceability and unambiguously identify the tests to be performed in the laboratory.

The sample identification coding process begins with the assignment of a unique alphanumeric job number. A job is defined as a group of samples received on the same day, from a specific client pertaining to a specific project. A job may consist of groups of samples received over multi-day period. The first character of the job number is an alpha-character that identifies the laboratory facility. The next characters are numeric and sequence by one number with each new job.

Unique sample numbers are assigned to each bottle collected as a discrete entity from a designated sample point. This number begins with the job number and incorporates a second series of numbers beginning at one and continuing chronologically for each point of collection. The test to be performed is clearly identified on the bottle label.

Alpha suffixes may be added to the sample number to identify special designations such as subcontracted tests, in-house QC checks, or re-logs. Multiple sample bottles for a specific analysis are labeled Bottle 1, Bottle 2, etc.

Subcontracted Analysis. Subcontract laboratories are employed to perform analysis not performed by SGS - Orlando. The quality assurance staff evaluates subcontract laboratories to assure their quality processes meet the standards of the environmental laboratory industry prior to engagement. Throughout the subcontract process, SGS - Orlando follows established procedures to assure that sample custody is maintained and the data produced by the subcontractor meets established quality criteria.

SGS - Orlando network laboratories are considered primary subcontractors.

Subcontracting Procedure. Subcontracting procedures are initiated through several mechanisms, which originate with sample management. Samples for analysis by a subcontractor are logged into the SGS - Orlando system using regular login procedures. If subcontract parameters are part of the project or sample management has received subcontracting instructions for a specific project, a copy of the chain of custody is given to the appropriate project manager with the subcontracted parameters highlighted. This procedure triggers the subcontract process at the project management level. The Sample Management supervisor contacts an approved subcontractor to place the subcontract order. Subcontract chain of custody is processed in Sample Management Department and copy is filed with the original CoC. Sample management signs the subcontract chain of custody and ships the sample(s) to the subcontractor. The subcontract COC is filed with the original COC and the request for subcontract. Copies are distributed to the login department, the project manager, and sample management.

Client is verbally notified by Project Manager of the requirement to subcontract to the outside laboratory as soon as need is identified by the SGS - Orlando staff. Client notification must be verified in writing, i.e. by e-mail. Client notification may take place during the initial project set-up, or at the time of sample receipt and login.

Subcontractor data packages are reviewed by the QA Staff to assess completeness and quality compliance. If completeness defects are detected, the subcontractor is asked to immediately upgrade the data package. If data quality defects are detected, the package is forwarded to the QA staff for further review. The QA staff will pursue a corrective action solution before releasing data to the client.

Approved subcontract data is entered into the laboratory information management system (LIMS) if possible and incorporated into the final report. All subcontract data is footnoted to provide the client with a clear indication of its source. Copies of original subcontract data are always included in the data report whether in hardcopy or PDF file, depending on the data submission requirements.

*Subcontract Laboratory Evaluation***.** The QA staff evaluates subcontract laboratories prior to engagement. As a minimum, the subcontract laboratory must provide SGS - Orlando with proof of a valid certification to perform the requested analysis for the venue where they were collected, QC criteria summary (LOD/LOQ, LCS, MS/MSD, %RPD, etc.), copy of the most recent regulatory agency audit report, and a copy of the laboratory’s Summary of Qualifications (SOQ). Other beneficial materials are QSM, copies of SOPs used for the subcontracted analysis, a copy of the most recent performance evaluation study for the subcontracted parameter, and copies of the most recent third party accreditor’s audit report.

Certification verification must be submitted to SGS - Orlando annually. If possible, the QA staff may conduct a site visit to the laboratory to inspect the quality system. SGS - Orlando assumes the responsibility for the performance of all subcontractors who have successfully demonstrated their qualifications. When selecting a subcontractor for analysis not performed by SGS - Orlando, assure qualifications of the subcontractor through local QA officer.

Qualification process of a subcontract laboratory may be bypassed if the primary client directs SGS - Orlando to employ a specific subcontractor

Subcontract Laboratory Database. SGS - Orlando maintains centralized database of preferred contractors in order to optimize sample handling and data submission process, as well as obtain competitive priced services of uniform quality throughout the network. Individual SGS - Orlando facilities are assigned “Center of Expertise” status according to unique capabilities.

<u>Sample Storage</u>. Following sample custody transfer, samples are assigned to various refrigerated storage areas by the sample management staff depending upon the test to be performed and the matrix of the samples. The location (refrigerator and shelf) of each sample is entered into sample location database on the line corresponding to each sample number. Samples remain in storage until the laboratory technician retrieves them into the laboratory for analysis.

Samples for volatile organics analysis are placed in storage in designated refrigerators by the sample management staff and immediately transferred to the organics group control. Sample custody is transferred to the VOC department staff. These samples are segregated according to matrix to limit opportunities for cross contamination to occur.

Organics staff is authorized to retrieve samples from these storage areas for analysis. When analysis is complete, the samples are placed back into storage.

Sample Login. Following sample custody transfer to the laboratory, the documentation that describes the clients analytical requirements are delivered to the sample login group for coding and entry to the Laboratory Information management System (LIMS). This process translates all information related to collection time, turnaround time, sample analysis, and deliverables into a code which enables client requirements to be electronically distributed to the various departments within the laboratory for scheduling and execution.

The technical staff is alerted to client or project specific requirements through the use of a unique project code that is electronically attached to the job during login. The unique project code directs the technical staff to controlled specifications documents detailing the unique requirements.

Sample Retrieval for Analysis. It is a responsibility of individual analyst to retrieve samples for analysis. Sample Management employs a program to facilitate sample placement and retrieval. Sample is traced around the laboratory using Status feature of LIMS.

After sample analysis has been completed, the analyst places the sample back into the storage and updates sample status.

Sample Disposal. SGS - Orlando retains all samples under proper storage for a minimum of 30 days following completion of the analysis report. Longer storage periods are accommodated on a client specific basis if required. Samples may also be returned to the client for disposal.

SGS - Orlandodisposes of all laboratory wastes following the requirements of the Resource Conservation and Recovery Act (RCRA). The Company has obtained and maintains a waste generator identification number, FLR00001263309002 (FLR designates State of Florida).

Sample management generates a sample disposal dump sheet from the LIMS tracking system each week, which lists all samples whose holding period has expired. Data from each sample is compared to the hazardous waste criteria established by the Florida Department of Environmental Protection (FDEP).

Samples containing constituents at concentrations above the criteria are labeled as hazardous and segregated into the following waste categories for disposal as follows:

Chlorinated Waste (Closed Top Steel Drum)- Methylene Chloride

Non-Chlorinated Waste (Closed Top Steel Drum)- Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal (Open Top Steel Drum)- Charcoal and paper filters used in the filtering of samples.

Hazardous Flammable Vials (Open Top Polypropylene Drum)- Methylene Chloride, Hexane.

Hazardous Aqueous waste (Closed Top Polypropylene Drum)- High Odor Samples, Lachat Waste.

Non Hazardous Soil (Open Top Steel Drum)- Soils.

Hazardous Solid Waste- (Open Top Steel Drum).

Non-Aqueous/Oil Samples- (Closed Top Steel Drum)

Difference between Open and Closed type of drums is whether it is possible to remove entire lid or just threaded stopper. Drums are closed at all times while in storage.

Non-hazardous aqueous samples are neutralized and collected in HDPP 500 Gal holding tank to be removed by waste company.

Non-hazardous solids are drummed and disposed of by contract waste company. Sample bottles are disposed of as recyclable waste in order to crush the bottles and destroy the labels. VOC vials are crushed on site using PRODEVA glass crusher. Supernatant liquid is siphoned off into the HDPP holding tank and solid residue drummed separately.

Laboratory wastes are collected by waste stream in designated areas throughout the laboratory. Waste streams are consolidated twice a week by the waste custodian and transferred to stream specific drums for disposal through a permitted waste management contractor. Filled, consolidated drums are tested for hazardous characteristics and scheduled for removal from the facility for appropriate disposal based on the laboratory data.

LABORATORY INSTRUMENTATION AND MEASUREMENT STANDARDS

Requirement: Procedures, which assure that instrumentation is performing to a pre-determined operational standard prior to the analysis of any samples, must be established by the laboratory. In general, these procedures will follow the regulatory agency requirements established in promulgated methodology. The instrumentation selected to perform specified analysis is capable of providing the method-specified uncertainty and sufficient sensitivity of measurement needed. These procedures must be documented and incorporated into the standard operating procedures for the method being executed. SASE Equipment List attached as Appendix III.

Mass Tuning – Mass Spectrometers. The mass spectrometer tune and sensitivity must be monitored to assure that the instrument is assigning masses and mass abundances correctly and that the instrument has sufficient sensitivity to detect compounds at low concentrations. This is accomplished by analyzing a specific mass tuning compound at a fixed concentration. If the sensitivity is insufficient to detect the tuning compound, corrective action must be performed prior to the analysis of standards or samples. If the mass assignments or mass abundances do not meet criteria, corrective action must be performed prior to the analysis of standards or samples.

Wavelength Verification – Spectrophotometers. Spectrophotometer detectors are checked on a regular schedule to verify proper response to the wavelength of light needed for the test in use. If the detector response does not meet specifications, corrective action (detector adjustment or replacement) is performed prior to the analysis of standards or samples.

Inter-element Interference Checks (Metals). Inductively Coupled Plasma Emission Spectrophotometers (ICP) are subject to a variety of spectral interferences, which can be minimized or eliminated by applying interfering element correction factors and background correction points. Interfering element correction factors are checked on a specified frequency through the analysis of check samples containing high levels of interfering elements. Analysis of single element interferent solutions is also conducted at a specified frequency.

If the check indicates that the method criteria has not been achieved for any element in the check standard, the analysis is halted and data from the affected samples are not reported. Sample analysis is resumed after corrective action has been performed and the correction factors have been re-calculated.

New interfering element correction factors are calculated and applied whenever the checks indicate that the correction factors are no longer meeting criteria. At a minimum, correction factors are replaced once a year.

__Calibration and Calibration Verification__. Many tests require calibration using a series of reference standards to establish the concentration range for performing quantitative analysis. Method specific procedures for calibration are followed prior to any sample analysis.

Calibration is performed using a linear or quadratic regression calculation or calibration factors calculated from the curve. The calibration must meet method specific criteria for linearity or precision. If the criteria are not achieved, corrective action (instrument maintenance or re-calibration) is performed. The instrument must be successfully calibrated before analysis of samples can be conducted.

Initial calibration for metals analysis performed using inductively coupled plasma (ICP) employs the use of two standards and a calibration blank to establish linearity. The calibration blank contains all reagents that are placed into the calibration standard with the exception of the target elements. Valid calibration blanks must not contain any target elements.

Initial calibrations must be initially verified using a single concentration calibration standard from a second source (i.e. separate lot or different provider). The continuing validity of an existing calibration must be regularly verified using a single concentration calibration standard. The response to the standard must meet pre-established criteria that indicate the initial calibration curve remains valid. Samples must be bracketed by passing CCVs. If the criteria are not achieved corrective action (re-calibration) is performed before any additional samples may be analyzed.

__Linear Range Verification and Calibration__ Linear range verification is performed for all ICP, ICP/MS and select General Chemistry methods. The regulatory program or analytical method specifies the verification frequency. A series of calibration standards are analyzed over a broad concentration range. The data from these analyses are used to determine the valid analytical range for the instrument.

Some methods or analytical programs require a low concentration calibration check to verify that instrument is sufficient to detect target elements at the reporting limit. The analytical method or regulatory program defines the criteria used to evaluate the low concentration calibration check. If the low calibration check fails criteria, corrective action is performed and verified through reanalysis of the low concentration calibration check before continuing with the field sample analysis.

In accordance with TNI standards minimum number of calibration points in the absence of method-specific requirements is two calibration points and a blank.

__Retention Time Verification (GC/HPLC/IC)__. Chromatographic retention time windows are developed for all analysis performed using gas chromatographs with conventional detectors. An initial experimental study is performed, which establishes the width of the retention window for each compound. The retention time range of the window defines the time ranges for elution of specified target analytes on the primary and confirmation columns. Retention time windows are established upon initial calibration, applying the retention time range from the initial study to each target compound. Retention times are regularly confirmed through the analysis of an authentic standard during calibration verification. If the target analytes do not elute within the defined range during calibration verification, the instrument must be recalibrated and new windows defined. New studies are performed when major changes, such as column replacement are made to the chromatographic system.

INSTRUMENT MAINTENANCE

***Requirement*.** Procedures must be established for equipment maintenance. The procedure may include a maintenance schedule if required or documentation of daily maintenance related activities. All instrument maintenance activities must be documented in instrument specific logbooks. All equipment out of service (both analytical and auxiliary) must be clearly marked “Out of Order”.

Routine, Daily Maintenance. Routine, daily maintenance is required on an instrument specific basis. It is performed each time the instrument is used. Daily maintenance traditionally includes activities to insure a continuation of good analytical performance. In some cases, they include performance checks that indicate whether non-routine maintenance is required. If the performance check indicates a need for higher level maintenance, the equipment is taken out of service until maintenance is performed. Analysis cannot be continued until the performance checks meet established criteria. Document return to control. Daily maintenance is the responsibility of the individual assigned to the instrument used for the analysis he is performing.

Non-routine Maintenance. Non-routine maintenance is reserved for catastrophic occurrences such as instrument failure. The need for non-routine maintenance is indicated by failures in general operating systems that result in an inability to conduct required performance checks or calibration. Equipment in this category are taken out of service and repaired before attempting further analysis. Analysis cannot continue until the instrument meets all performance check criteria and is capable of being calibrated. Section supervisors are responsible for identifying non-routine maintenance episodes and initiating repair activities to bring the equipment on-line. This may include initiating telephone calls to maintenance contractors if necessary. They are also responsible for documenting all details related to the occurrence and the repair.

Scheduled Maintenance*.* Modern laboratory instrumentation rarely requires traditional scheduled maintenance. Where required, the equipment is placed on a schedule, which dictates when maintenance is required. Examples include annual balance calibration by an independent provider and pump oil changes. Section supervisors are responsible for initiating scheduled maintenance on equipment that requires scheduled preventative attention. Scheduled maintenance is documented using routine documentation practices.

Maintenance Documentation. Routine and non-routine maintenance activities are documented in logbooks assigned to instruments and equipment used for analytical measurements. The logbooks contain preprinted forms, which specify the maintenance activities required with each use. SGS - Orlando has adopted a problem – action – follow-up format to conduct instrument maintenance. The analyst or supervisor who performs or initiates the maintenance activity is required to check the activity upon its completion, verify complete statement of return to normal conditions and initial the form. Non-routine maintenance (i.e. repairs, upgrades, etc.) is documented as well either electronically via e-mail from the service provider or receipt attached to the maintenance log.

QUALITY CONTROL PARAMETERS, PROCEDURES, AND CORRECTIVE ACTION

Requirement: All procedures used for test methods must incorporate quality control parameters to monitor elements that are critical to method performance. Each quality parameter includes acceptance criteria that have been established by regulatory agencies for the methods in use. Criteria may also be established through client dictates or through the accumulation and statistical evaluation of internal performance data. Data obtained from these parameters must be evaluated by the analyst, and compared to established method criteria. If the criteria are not achieved, the procedures must specify corrective action and conformation of control before proceeding with sample analysis. QC parameters, procedures, and corrective action must be documented within the standard operating procedures for each method. In the absence of client specific objectives the laboratory must define qualitative objectives for completeness and representativeness of data.

Procedure. Bench analysts are responsible for methodological quality control and sample specific quality control. Each method specifies the control parameters to be employed for the method in use and the specific procedures for incorporating them into the analysis. These control parameters are analyzed and evaluated with every designated sample group (batch).

The data from each parameter provides the analyst with critical decision making information on method performance. The information is used to determine if corrective action is needed to bring the method or the analysis of a specific sample into compliance. These evaluations are conducted throughout the course of the analysis. Each parameter being indicative of a critical control feature. Failure of a methodological control parameter is indicative of either instrument or batch failure. Failure of a sample control parameter is indicative of control difficulties with a specific sample or samples.

Sample Batch. All samples analyzed in the laboratory are assigned to a designated sample batch, which contains all required quality control samples and a defined maximum number of field samples that are prepared and/or analyzed over a defined time period. The maximum number of investigative and field QC samples in the batch is 20. SGS - Orlando has incorporated the TNI batching policy as the sample-batching standard. This policy incorporates the requirement for blanks and spiked blanks as a time based function as defined by TNI. The typical batch contains a blank, laboratory control sample (LCS or spiked blank), matrix spike and matrix spike duplicate. Batch documentation includes lot specifications for all reagents and standards used during preparation of the batch.

Methodological Control Parameters and Corrective Action. Prior to the analysis of field sample the analyst must determine that the method is functioning properly. Specific control parameters indicate whether critical processes meet specified requirements before continuing with the analysis. Method specific control parameters must meet criteria before sample analysis can be conducted. Each of these parameters is related to processes that are under the control of the laboratory and can be adjusted if out of control.

Method Blank. A method blank is analyzed during the analysis of any field sample. The method blank is defined as a sample. It contains the same standards (internal standards, surrogates, matrix modifiers, etc.) and reagents that are added to the field sample during analysis, with the exception of the sample itself. If the method blank contains target analyte(s) at concentrations that exceed method or client requirements (typically defined as 1/2 RL concentrations), the source of contamination is eliminated before proceeding with sample analysis. Systematic contamination is documented for corrective action and resolved following the established corrective action procedures. In specific cases, contamination detected in the method blank may be acceptable if the concentrations do not exceed regulatory limits or client defined reporting limits.

Laboratory Control Samples (LCS or Spiked Blanks). A laboratory control sample (spiked blank or commercially prepared performance evaluation sample) is analyzed along with field samples to demonstrate that the method accuracy is within acceptable limits. These spike solutions are derived from different sources than the solutions used for method calibration. The performance limits are derived from published method specifications or from statistical controls generated from laboratory method performance data. Spiked blanks are blank matrices (reagent water, clean sand, Teflon chips, or granular sodium sulfate) spiked with the targeted parameters and analyzed using the same method used for samples. Accuracy data is compared to laboratory experimentally derived limits to determine if the method is in control. Laboratory control samples (LCS) may be laboratory or commercially prepared spiked samples in an inert material.

Accuracy data is compared to the applicable performance limits. If the spike accuracy exceeds the performance limits, corrective action, as specified in the SOP for the method is performed and verified before continuing with a field sample analysis. In some cases, decisions are made to continue with sample analysis if performance limits are exceeded; provided the unacceptable result has no negative impact on the sample data.

Marginal exceedance (ME) values are calculated for methods containing more than eleven (11) targeted analytes. The ME is calculated as ± 4 standard deviations about the mean. MEs are considered for multi-analyte methods because of the increased likelihood of LCS failure as the number of analytes in the method increase. The number of allowable MEs is based on the number of target analytes in the method. Analytes that regularly fall into the ME category are treated as systematic problems, which are resolved using established trend monitoring and corrective action procedures. Marginal Exceedances are not applied to parameters that are detected in field samples. Routine corrective action is initiated for all cases where LCS spike accuracy criteria is beyond the established control limits and the parameter is detected in field samples corresponding to the unacceptable LCS. Use of ME may be disallowed on project-specific basis. Use of ME may be disallowed or limited on State-specific basis; of note are the Commonwealth of Massachusetts (demonstrated low bias) and State of South Carolina (complete prohibition).

Blanks and spikes are routinely evaluated before samples are analyzed. However, in situations where sample analysis is performed using an autosampler, they may be evaluated after sample analysis has occurred. If the blanks and spikes do not meet criteria, sample analysis is repeated.

Proficiency Testing. Performance Evaluation (Proficiency Testing) samples (PEs, PTs) are single or double blind samples spiked with known amount of analytes on interest and introduced to the laboratory to assess method performance. PEs may be introduced as double blinds submitted by commercial clients, single or double blinds from regulatory agencies, or internal blinds submitted by the QA group.

A minimum of two single blind studies must be performed each year for every parameter in aqueous and solid matrices for each field of proficiency testing (FOPT) for which the laboratory maintains accreditation. Proficiency Testing samples must be purchased as blinds from an accredited vendor for every combination of analyte-matrix-method. Data from these studies are provided to the laboratory by the vendor and reported to accrediting agencies. If unsatisfactory performance is noted, corrective action is performed to identify and eliminate any sources of error. A new PT must be analyzed to demonstrate continuing proficiency.

PE samples performed for accrediting agencies or clients, which do not meet performance specifications, require a written summary that documents the corrective action investigation, findings, and corrective action implementation.

Single or double blind PT samples are employed for self-evaluation purposes. Data from these analyses are compared to established performance limits. If the data does not meet performance specifications, the system is evaluated for sources of acute or systematic error. If required, corrective action is performed and verified before initiating or continuing sample analysis.

Trend Analysis for Control Parameters. Accuracy data for selected spiked parameters from the laboratory control sample (LCS) is statistically evaluated daily for trends. Data from selected LCS parameters and surrogates are pooled on a method, matrix, and instrument basis. This data is evaluated by comparison to existing control and warning limits. Trend analysis is performed automatically as follows:

- Any point outside the control limit
- Any three consecutive points between the warning and control limits
- Any eight consecutive points on the same side of the mean
- Any six consecutive points increasing or decreasing

The results of the trend analysis are printed for supervisory evaluation prior to sample analysis. Trends that indicate the potential loss of statistical control are further evaluated to determine the impact on data quality and to determine if corrective action is necessary. If corrective action is indicated, the supervisor informs the analysts of the corrective actions to be performed. Return to control is demonstrated before analysis resumes.

Sample Control Parameters and Corrective Action. The analysis of samples can be initiated following a successful demonstration that the method is operating within established controls. Additional controls are incorporated into the analysis of each sample to determine if the method is functioning within established specifications for each individual sample. Sample QC data is evaluated and compared to established performance criteria. If the criteria are not achieved the method or the SOP specifies the corrective action required to continue sample analysis. In many cases, failure to meet QC criteria is a function of sample matrix and cannot be remedied. Each parameter is designed to provide quality feedback on a defined aspect of the sampling and analysis episode.

Duplicates. Duplicate sample analysis is used to measure analytical precision. This can also be equated to laboratory precision for homogenous samples. Precision criteria are method dependent. If precision criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Laboratory Control Duplicate, Spikes & Spiked Duplicates. Spikes and spiked duplicates are used to measure analytical precision and accuracy for the sample matrix selected. Precision and accuracy criteria are method dependent. If precision and accuracy criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Serial Dilution (Metals). Serial dilutions of metals samples are analyzed to determine if analytical matrix effects may have impacted the reported data. If the value of the serially diluted samples does not agree with the undiluted value within a method-specified range, the sample matrix may be causing interference, which may lead to either a high or low bias. If the serial dilution criterion is not achieved, it must be flagged to indicate possible bias from matrix effects. SGS - Orlando *uses this procedure as opposed to post-digestion spike unless contractual obligations absolutely require latter*

Post Digestion Spikes (Metals). Digested samples are spiked and analyzed to determine if matrix interferences are creating biases in the results. It may also be used to determine potential interferences per client's specification. Spike concentration is determined as per analytical method. No action is necessary if the post digestion spike is outside of the method criteria, unless a preparation problem is suspected with the spike, in which case the post digestion spike should remade and reanalyzed.

Surrogate Spikes (Organics). Surrogate spikes are organic compounds that are similar in behavior to the target analytes but unlikely to be found in nature. They are added to all quality control and field samples to measure method performance for each individual sample. Surrogate accuracy limits are derived from published method specifications or by statistical evaluation of laboratory generated surrogate accuracy data. Accuracy data is compared to the applicable performance limits. If the surrogate accuracy exceeds performance limits, corrective action, as specified in the method or SOP is performed before sample data can be reported.

Internal Standards (Organic Methods). Internal standards are retention time and instrument response markers added to every sample to be used as references for quantitation. Their response is compared to reference standards and used to evaluate instrument sensitivity on a sample specific basis. Internal standard retention time is also compared to reference standards to assure that target analytes are capable of being located by their individual relative retention time.

If internal standard response criteria are not achieved, corrective action or additional action may be required. The recommended action must be completed before sample data can be reported.

If the internal standard retention time criteria are not achieved corrective action or additional action may be required. This may include re-calibration and re-analysis. Additional action must be completed before sample data is reported.

Internal Standards (ICP and ICP-MS Metals). Internal standards are used on ICP instruments to compensate for variations in response caused by differences in sample matrices. This adjustment is performed automatically during sample analysis. The internal standard response of replicated sample analysis is monitored to detect potential analytical problems. If analytical problems are suspected, then the field samples are reanalyzed.

Laboratory Derived Quality Control Criteria. Control criteria for in-house methods and client specific modifications that exceed the scope of published methodology are defined and documented prior to the use of the method. The Quality Assurance staff identifies the responsibility for control criteria needs. Control parameters and criteria, based on best technical judgment are established using input provided by the operations staff. These control parameters and criteria are documented and incorporated into the method.

The laboratory derived criteria are evaluated for technical soundness on spiked samples prior to the use of the method on field samples. The technical evaluation is documented and archived by the Quality Assurance staff.

When sufficient data form the laboratory developed control parameter is accumulated, the data is statistically processed and the experimentally derived control limits are incorporated into the method.

Bench Review & Corrective Action. The bench chemists are responsible for all QC parameters. Before proceeding with sample analysis, they are required to successfully meet all instrumental QC criteria. They have the authority to perform any necessary corrective action before proceeding with sample analysis. Their authority includes the responsibility for assuring that departures from documented policies and procedures do not occur.

The bench chemists are also responsible for all sample QC parameters. If the sample QC criteria are not achieved, they are authorized and required to perform the method specified corrective action before reporting sample data.

Data Qualifiers**.** An alpha character coding system is employed for defining use limitations for reported data. These limitations are applied to analytical data by the analyst to clarify the usefulness of the reported data for data user. SGS - Orlando qualifies data in accordance with program-specific requirements, such as State of Florida DEP, DoD QSM, etc., and these qualifiers are hard-coded in the LIMS on project level. Definitions of common qualifiers could be found at the bottom of the sample report form.

QA Monitoring. The QA staff prior to client release conducts a spot review of completed data packages. This review includes an examination of QC data for compliance and trends indicative of systematic difficulties. If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation. The data package is released when the package becomes compliant with all quality requirements.

If the review reveals trends indicative of systematic problems, QA initiates an investigation to determine the cause. If process defects are detected, a corrective action is implemented and monitored for effectiveness.

Performance Limits. The Technical Director is responsible for compilation and maintenance of all precision and accuracy data used for performance limits. Quality control data for all test methods are accumulated and stored in the laboratory information management system (LIMS). Parameter specific QC data is extracted annually and statically processed to eliminate outliers and develop laboratory specific warning limits and confidence limits. The new limits are reviewed and approved by the supervisory staff prior to their use for data assessment. The new limits are used to evaluate QC data for compliance with method requirements for a period of one year. Laboratory generated limits appear on all data reports unless method specifies hard-coded limits (mostly General Chemistry and Metals)

Data Package Review. SGS - Orlando employs multiple levels of data review to assure that reported data has satisfied all quality control criteria and that client specifications and requirements have been met. Production departments have developed data review procedures which must be conducted before data is released to the client.

Analytical Review. The analyst conducts the primary review of all data. This review begins with a check of all instrument and method quality control and progresses through sample quality control concluding with a check to assure that the client's requirements have been executed. Analyst checks focuses on a review of qualitative determinations and checks of precision and accuracy data to verify that existing laboratory criteria have been achieved. Checks at this level may include comparisons with project specific criteria if applicable. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.

Secondary data reviews are performed at the peer level by analysts who have met the qualification criteria for the method in use. Qualification requirements include a valid demonstration of capability and demonstrated understanding of the method SOP. Section supervisors may perform secondary review in-lieu of a peer review Secondary review is performed on 100% of the data produced by their department. It includes a check of all manual calculations; an accuracy check of manually transcribed data from bench sheets to the LIMS, a check of all method and instrument QC criteria, baseline manipulations (if applicable) and a comparison of the data package to client specified requirements. Also included are checks to assure the appropriate methodology was applied and that all anomalous information was properly flagged for communication in the case narrative. Supervisors have the authority to reject data and initiate re-analysis, corrective action, or reprocessing.

All laboratory data requiring manual entry into LIMS system is double-checked by the analysts performing initial data entry and the section supervisor. Verification of supervisory review is indicated on the raw data summary by the supervisor's initials and date.

Electronic data that is manually edited at the bench by the primary analysts is automatically flagged by the instrument data system indicating an override by the analyst. All manual overrides must be verified and approved by a supervisor who initials and dates all manual changes.

Hard copies of manually integrated chromatographic peaks are printed that clearly depict the manually drawn baseline. The hard copy is reviewed and approved by the reviewer (initialed and dated) and included in the data package of all full tier reports or the archived batch records of commercial report packages.

Electronic data that has been committed to the LIMS can only be edited by a manager or supervisor. These edits may be required if needs for corrections are indicated during the final review. An audit record for all electronic changes in the LIMS is automatically appended to the record.

The section leader performs a tertiary review on a spot check basis. This review includes an evaluation of QC data against acceptance criteria and a check of the data package contents to assure that all analytical requirements and specifications were executed.

Report Generation (Administrative) Review. The report generation group reviews all data and supporting information delivered by the laboratory for completeness and compliance with client specifications. Missing deliverables are identified and obtained from the laboratory. The group also reviews the completed package to verify that the delivered product complies with all client specifications. Non-analytical defects are corrected before the package is sent to the client.

Project Management/Quality Assurance Review. Spot-check data package reviews are performed by the project manager. Project management reviews focus on project specifications. If the project manager identifies defects in the product prior to release, he initiates immediate corrective action to rectify the situation.

The QA Staff reviews approximately 10% of the data produced. The QA review focuses on all elements of the deliverable including the client's specifications and requirements, analytical quality control, sample custody documentation and sample identification. QA reviews at this step in the production process are geared towards systematic process defects, which require procedural changes to effect a corrective action. However, if defects are identified that can be corrected prior to data release, the QA staff returns the package to the laboratory for corrective action. QA data review cannot be used in lieu of a peer level review or a supervisory review.

Data Reporting. Analytical data is released to clients following secondary departmental review. Data release at this stage of the process is limited to electronic information, which is released to clients through a secure, encrypted, password protected, Internet connection.

Hard copy support data is compiled by the report generation group and assembled into the final report. The report is sent to the client following administrative review by report generation staff, and spot-check by QA staff.

All data reports include specified information, which is required to identify the report and its contents. This information includes a title, name and address of the laboratory, a unique report number, total number of pages in the report, clients name and address, analytical method identification, arriving sample condition, sampling, preparation/digestion/extraction and analysis dates, test results with units of measurement, authorized signature of data release, statement of applicability, report reproduction restrictions and TNI requirements certification. Subcontracted data is clearly identified.
Laboratory might be required either by State-specific program or federal program(s) to identify certification status and certification exceptions of the analyses performed.

Examples include TNI 2009/2016 standards, DoD Ver. 5.x and 310 CMR 42 (Massachusetts). For accreditation status review see sec. 14.1.

In the event of report revision date of the revision, nature of revision and identity of the person revising the report must be clearly stated in the body of the report. All levels of deliverables incorporate letter(s) of report reissue into all subsequent reports. This letter(s) is addressed to the client and briefly outlines reasons for report revision.

Electronic Data Reduction. Raw data from sample analysis is entered into the laboratory information management system (LIMS) using automated processes or manual entry. Final data processing is performed by the LIMS using procedures developed by the Company.

All LIMS programs and internally developed software (including Excel spreadsheets) are tested and validated prior to use to assure that they consistently produce correct results. Validation testing is performed by the Information Technology Staff. The testing procedures are documented in an SOP. Programs are not approved for use until they have demonstrated that they are capable of performing the required calculations.

Representativeness. Data representativeness is based on the premise that qualitative and quantitative information developed for field samples is characteristic of the sample that was collected by the client and analyzed in the laboratory. The laboratory objective for representativeness defines data as representative if the criteria for all quality parameters associated with the analysis of the sample are achieved.

Comparability. Analytical data is defined as comparable when data from a sample set analyzed by the laboratory is representatively equivalent to other sample sets analyzed separately regardless of the analytical logistics. The laboratory will achieve 100% comparability for all sample data which meets the criteria for the quality parameters associated with its analysis using the method requested by the client.

CORRECTIVE ACTION SYSTEM

Requirement. The laboratory must have policies and procedures for correcting defective processes, systematic errors, and quality defects, which enables the staff to systematically improve product quality. The system must include procedures for communicating items requiring corrective action, corrective action tracking procedures, corrective action documentation, monitoring of effectiveness, and reports to management. The system must be documented in a standard operating procedure.

Procedure. Corrective action is the step that follows the identification of a process defect. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance.

Routine Corrective Action. Routine corrective action is defined as the procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical quality control parameters or analytical system specifications.

Bench analysts have full responsibility and authority for performing routine corrective action. The resolution of defects at this level does not require a procedural change or staff re-training. The analyst is free to continue work once corrective action is complete and the analytical system has been returned to control. Documentation of routine corrective action is limited to bench logbook or maintenance logbook comment.

Process Changes. Corrective actions in this category require procedural modifications. They may be the result of systematic defects identified during audits, the investigation of client inquiries, failed proficiency tests, product defects identified during data review, or method updates. Resolution of defects of this magnitude requires formal identification of the defect, development and documentation of a corrective action plan, and staff training to communicate the procedural change.

Technical Corrective Action. Technical corrective action encompasses routine corrective action performed by bench analysts for out of control systems and corrective actions performed for data produced using out of control systems. Technical corrective action for routine situations is conducted using the procedures detailed above.

Non-routine corrective actions apply to situations where the bench analysts failed to perform routine corrective action before continuing analysis. Supervisors and Department Managers perform corrective action in these situations. Documentation of all non-routine corrective actions is performed using the corrective action system.

Sample re-analysis is conducted if sufficient sample and holding time remain to repeat the analysis using an in-control system. If insufficient sample or holding time remains, the data is processed and qualifiers applied that describe the out of control situation. The occurrence is further documented in the case narrative and in the corrective action response. The corrective action must include provisions for retraining the analysts who failed to perform routine corrective action.

Documentation & Communication. Routine corrective actions are documented as part of the analytical record. Notations are made in the comments section of the analytical chronicle or data sheet detailing the nonconformance. Continuation of the analysis indicates that return to control was successful.

Corrective actions for process changes are documented, tracked and monitored for effectiveness. Corrective actions may be initiated by any supervisor or senior staff member by completing the corrective action form in Corrective Action database

The corrective action database is an Access application. The initiator generates the corrective action investigation form, which is documented, tracked, distributed to responsible parties and archived through the application. The application assigns a tracking number initiation data and due date to each corrective action initiated and copies the corrective action form to the corrective action database. The application also distributes an E-mail message containing the form to the responsible parties for resolution.

Corrective Action system employs Deficiency – Root Cause – Immediate Fix – Corrective action approach, further divided into categories of Analytical Error, Omission Error, Random Error, Systemic Error and Training Issue.

The responsible party develops and implements the procedural change. Existing documentation such as SOPs are edited to reflect the change. The affected staff is informed of the procedural change through a formal training session. The training is documented and copies are placed into individual training files. The corrective action form is completed and closed in CA database.

Initial and completed corrective action forms are maintained in the Corrective Action directory. This information is archived daily. Copies of training records describing corrective actions are appended to the involved individuals training files.

Monitoring. The QA Staff monitors the implemented corrective action until it is evident that the corrective action has been effective and the systematic deficiency has been eliminated. The corrective action database is updated by QA to reflect closure of the corrective action. The QA staff also assigns an error code to the corrective action for classification of the type of errors being committed.

If QA determines that the corrective action procedure has not effectively remedied the deficiency, the process continues with a re-initiation of the corrective action. Corrective action continues until the defective process is eliminated. If another procedural change is required, it is treated as a new corrective action, which is documented and monitored using established procedures.

Client Notification. Defective processes, systematic errors, and quality defects, detected during routine audits may have negative impacts on data quality. In some cases, data that has been released to clients may be affected. If defective data has been released for use, SGS - Orlando will notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

PROCEDURES FOR EXECUTING CLIENT SPECIFICATIONS

***Requirement*.** Systems must be established for evaluating and processing client specifications for routine and non-routine analytical services. The systems must enable the client services staff to identify, evaluate, and document the requested specifications to determine if adequate resources are available to perform the analysis. The system must include procedures for communicating the specifications to the laboratory staff for execution and procedures for verifying the specifications have been executed.

Client Specific Requirements. The project manager is the primary contact for clients requesting laboratory services. Client specifications are communicated using several mechanisms. The primary source of information is the client's quality assurance project plan (QAPP) which details analytical and quality control specifications for the project. In the absence of a QAPP, projects specifications can also be communicated using contracts, letters of authorization, or letters of agreement, which may be limited to a brief discussion of the analytical requirements and the terms and conditions for the work. These documents may also include pricing information, liabilities, scope of work, in addition to the analytical requirements. QAPPs include detailed analytical requirements and data quality objectives, which supersede those found in the referenced methods. This information is essential to successful project completion.

Laboratory also reviews its Accreditation status to evaluate whether it is possible to accept proposed project. Discrepancies must be resolved before the work commences.

The client services staff provides additional assistance to clients who are unsure of the specifications they need to execute the sampling and analysis requirements of their project. They provide additional support to clients who require assistance in results interpretation as needed, provided they possess the expertise required to render an opinion.

The project manager is responsible for obtaining project documents, which specify the analytical requirements. Following project management review, copies are distributed to the QA staff and the appropriate departmental managers for review and comment. The original QAPP is numbered with a document control number and filed in a secure location.

Requirements for Non-Standard Analytical Specifications. Client requirements that specify departures from documented policies, procedures, or standard specifications must be submitted to SGS - Orlando in writing. These requirements are reviewed and approved by the technical staff before the project is accepted. Once accepted, the non-standard requirements become analytical specifications, which follow the routine procedure for communicating client specifications. Departures from documented policies, procedures, or standard specifications that do not follow this procedure are not permitted.

Exception Policy: With respect to the quality system, incoming non-conforming product refers to received samples that do not meet requirements of custody documentation, are improperly packaged or stored or are contaminated. An internal non-conformance refers to a problem, caused internally due to improper handling of samples, improper sampling methods, and equipment malfunction or data management errors. The individual who identifies the incoming non-conformance is responsible for notifying the project manager. The project manager resolves the issue with the client. The individual who recognizes an internal non-conformance is responsible for initiating corrective action

Departures from standard practices, policies and specifications are reviewed and approved by Technical Director, QA Officer and by Project Manager of the project affected.

Corrective & Preventative Action: Once a quality problem has been identified, the analytical or review process stops, until the reason is identified. Primary responsibility for identifying the cause of the problem rests with the instrument operator. Other staff may be called on to assist in reaching the root cause. The problem prevention tracking system, using Corrective Action Tracking Records, provides a method to track systemic problems until resolved/removed. The QA Officer is responsible for the record management with respect to the disposition of problems.

Deviations that do not limit themselves to a single department and/or client are cited on Corrective Action Record. This may include but not limited to: sample arrival outside of EPA specified holding time, analysis completion outside of EPA specified holding time (with explanation of the reason), inconsistencies between chain of custody and cooler contents, including labeling errors, improper preservation, etc.

Deviations from analytical methods' SOP's are reported by the Analyst to the Section Leader. Single occurrences warrant completion of Corrective Action Tracking record, repetitive occurrences may indicate that either an additional training session is in order, or that the SOP does not reflect proper laboratory practice. Training session is conducted by the Technical Director or by QA Officer. In case where SOP does not reflect current laboratory practice, SOP review and correction process may be initiated.

Evaluation of Resources. A resource evaluation is completed prior to accepting projects submitted by clients. The evaluation is initiated by the client services staff receives project requirements (usually in the form of QAPjP) and distributes these requirements to the laboratory departments affected. The specifications are evaluated by the department managers from a scheduling and hardware resources perspective. The project is not accepted unless the department managers have the necessary resources to execute the project according to client specifications.

Documentation. New projects are initiated using a project set up form, which is completed prior to the start of the project. This form details all of the information needed to correctly enter the specifications for each client sample into the laboratory information management system (LIMS, see example). The form includes data reporting requirements, billing information, data turnaround times, QA level, state of origin, and comments for detailing project specific requirements. The project manager is responsible for obtaining this information from the client and completing the form prior to sample arrival and login.

Sample receipt triggers project creation and the login process. The information on the set-up form is entered into the LIMS immediately prior to logging in the first sample. The set up form may be accompanied by a quotation, which details the analytical product codes and sample matrices. These details are also entered into the LIMS during login.

Special information is distributed to the laboratory supervisors and login department in electronic or hardcopy format upon project setup. All project specific information is retained by the project manager in a secure file. The project manager maintains a personal telephone log, which details conversations with the client regarding the project.

Communication. A pre-project meeting is held between client services and the operations managers to discuss the specifications described in the QAPjP and/or related documents. Project logistics are discussed and finalized and procedures are developed to assure proper execution of the client's analytical specifications and requirements. Questions, raised in the review meeting, are discussed with the client for resolution. Exceptions to any requirements, if accepted by the client, are documented and incorporated into the QAPjP or project documentation records.

Non-standard specifications for individual clients are documented in the LIMS at the client account level. Once entered into the LIMS, these specifications become memorialized for all projects related to the client account. Upon sample arrival, these specifications are accessed through a terminal or printed as a hard copy and stored in a binder for individuals who require access to the specification. Specifications that are not entered into the LIMS are prohibited unless documented in an interdepartmental memo, which clearly identifies the project, client and effective duration of the specification.

Operational Execution. A work schedule is prepared for each analytical department on a daily basis. Analytical specifications from recently arrived samples have now been entered into the LIMS database. The database is sorted by analytical due date and holding time, into product specific groups. Samples are scheduled for analysis by due date and holding time. The completed schedule, which is now defined as a work list, is printed. The list contains the client requested product codes and specifications required for the selected sample(s). Special requirements are communicated to the analyst using the comments section or relayed through verbal instructions provided by the supervisor. The bench analyst assumes full responsibility for performing the analysis according to the specifications printed on the work sheet.

Verification. Prior to the release of data to the client, laboratory section managers and the report generation staff review the report and compare the completed product to the client specifications documentation to assure that all requirements have been met. Project managers perform a spot check of projects with unique requirements to assure that the work was executed according to specifications.

CLIENT COMPLAINT RESOLUTION PROCEDURE

Requirement. A system for managing and reconciling client complaints must be implemented in the laboratory. The system must include procedures for documenting client complaints and communicating the complaint to the appropriate department for resolution. The system must also include a quality assurance evaluation to determine if the complaint is related to systematic defects requiring process changes.

Procedure. Client complaints are communicated to client services representatives, quality assurance staff, or senior management staff for resolution. The individual receiving the complaint retains the responsibility for documentation and communicating the nature of the complaint to the responsible department(s) for resolution. The responsible party addresses the complaint. The resolution is communicated to quality assurance (QA) and the originator for communication to the client. QA reviews the complaint and resolution to determine if systematic defects exist. If systematic defects are present, QA works with the responsible party to develop a corrective action that eliminates the defect.

Documentation. Client's complaints are documented by the client service representative receiving the complaint. A record of the telephone conversation is maintained by client services. Client service staff enters the complaint into Data Challenge database or Client Complaint database, depending on the nature of complaint. These databases are cross-linked with corrective action database – see sec. 13. Complaint is communicated to the production departments concerned via auto e-mail. The complaint resolution is documented in the database by the responsible party and resultant e-mail returned to the originator. QA staff is copied on the correspondence.

Corrective Action. Responses to Data Challenges/Client Complaints are required from the responsible party. At a minimum, the response addresses the query and provides an explanation to the complaint. Corrective action may focus on the single issue expressed in the complaint. Corrective action may include job case narrative generation, reprocessing of data, editing of the initial report, and re-issue to the client. If the QA review indicates a systematic error, process modification is required. The defective process at the root of the complaint is changed. SOPs are either created or modified to reflect the change. The party responsible for the process implements process changes.

QA Monitoring. Process changes, implemented to resolve systematic defects, are monitored for effectiveness by QA. If monitoring indicates that the process change has not resolved the defect, QA works with the department management to develop and implement an effective process. If monitoring indicates that the defect has been resolved, monitoring is slowly discontinued. Continued monitoring is incorporated as an element of the annual system audit and annual Management Report (see 18.8).

CONTROL OF NONCONFORMING PRODUCT

Requirement: Policies and procedures have been developed and implemented that describe the procedures employed by the laboratory when any aspect of sample analysis or data reporting do not conform to established procedures or client specifications. These procedures include steps to ensure that process defects are corrected and affected work is evaluated to assess its impact to the client.

Procedure. Nonconforming product is identified through multiple channels, such as second level analytical data review, routine internal review and audit practices, external auditing or through client inquiry. Responsibility and authority for the management of the non-conforming product is directly defined by a nature of a non-conformance. For example, non-conformances resulting from internal and external reviews are evaluated and managed by QA Staff. Corrective Action items are issued and followed to completion and verification that defect is prevented from reoccurring. Non-conformances stemming from client inquiry are managed by Project Management staff with QA staff oversight.

Data associated with out-of compliance QC are evaluated by bench personnel and section supervisors. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.

If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation

Non-conformances and their significance are communicated in case narrative and sample report footnotes. Case narrative comments and sample repot footnotes must state the impact on data quality.

Corrective Action. The outcome of the evaluation dictates the course of action. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance This may include at a minimum client notification, but may also include corrective action. Immediate corrective action is performed using the SOP-specified procedures. However, additional action may be required including cessation of analysis and withholding and/or recalling data reports. If the evaluation indicates that nonconforming data may have been issued to clients, the client is immediately notified and data may be recalled following the procedures specified in respective SOPs. If work has been stopped because of a nonconformance, the Laboratory Director is the only individual authorized to direct a resumption of analysis.

Non-conformances caused by systematic process defects require retraining of the personnel involved as an element of the corrective action solution. Routine corrective actions are documented as part of the analytical record.

CONFIDENTIALITY PROTECTION PROCEDURES

Requirements: Policies and procedures are required to protect client data from release to unauthorized parties or accidental release of database information through accidental electronic transmission or illegal intrusion. These policies must be communicated to clients and staff. Electronic systems must be regularly evaluated for effectiveness.

Client Anonymity. Information related to the Company's clients is granted to employees on a "need to know" basis. An individual's position within the organization defines his "need to know". Individuals with "need to know" status are given password access to systems that contain client identity information and access to documents and document storage areas containing client reports and information. Access to client information by individuals outside of the Company is limited to the client and individuals authorized by the client.

Individuals outside of the Company may obtain client information through subpoena issued by a court of valid jurisdiction. Clients are informed when subpoenas are received ordering the release of their information.

Documents. Access to client documents is restricted to employees in need to know positions. Copies of all client reports are stored in secure archive with restricted access. Reports and report copies are distributed to individuals who have been authorized by the client to receive them. Documents are not released to third parties without verbally expressed or written permission from the client.

Confidential Business Information (CBI). Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between SGS - Orlando and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only. See also Sec. 6.5.

Electronic Data.

Database Intrusion. Direct database entry is authorized for employees of SGS - Orlando only on a need to know basis. Entry to the database is restricted through a user specific multiple password entry system. Direct access to the database outside of the facility is possible through a VPN connection. A unique user and password is required for access to the local area network. A second unique password is required to gain access to the database. All Passwords are required to be changed semiannually. The staff receives read or write level authorization on a hierarchical privilege basis.

Internet Access. Access to client information is through an HTTPS Web application only. It does not contain a mechanism that allows direct access to the database. Clients can gain access to their data only using a series of SGS - Orlando assigned accounts, and client specific passwords. The viewable data, which is encrypted during transmission, consists of an extraction of database information only.

Client Accessibility. Accessibility to client data delivered via electronic means follows strict protocols to insure confidentiality. Clients accessing electronic data are assigned a company account. The account profile, which is established by the MIS staff, grants explicit access to explicit information pertaining to the client's project activity. Passwords are assigned on an individual basis within a client account. These accounts can be activated or deactivated by the MIS staff only.

Information Requests. Client specific data or information is not released to third parties without verbally expressed or written permission from the client. Written permission is required from third parties, who contact the Company directly for the release of information. Verbal requests will be honored only if they are received directly from the client. These requests must be documented in a record of communication maintained by authorized recipient.

Transfer of Records. Archived data, which has previously been reported and transmitted to clients, is the exclusive property of SGS - Orlando. In the event of a cessation of business activities due to business failure or sale, The Company's legal staff will be directed to arrange for the final disposition of archived data.

The final disposition of archived data will be accomplished using the approach detailed in the following sequence:

1. All data will be transferred to the new owners for the duration of the required archive period as a condition of sale.

2. If the new owners will not accept the data or the business has failed, letters will be sent to clients listed on the most recent active account roster offering them the option to obtain specific reports (identified by SGS – Orlando Job Number) at their own expense.

3. A letter will be sent to the TNI accrediting authority with organizational jurisdiction over the company offering them the option to obtain all unclaimed reports at their own expense.

4. All remaining archived data will be recycled using the most expedient means possible.

QUALITY AUDITS AND SYSTEM REVIEWS

Requirement: The quality assurance group will conduct regularly scheduled audits of the laboratory to assess compliance with quality system requirements, technical requirements of applied methodology, and adherence to documentation procedures. The information gathered during these audits will be used to provide feedback to senior management and perform corrective action where needed for quality improvement purposes.

Quality Systems Review. Quality system audits are performed annually by the Quality Assurance Director for the VP of EHS. In this audit, the laboratory is evaluated for compliance with the Laboratory Quality Systems Manual (LQSM) and the quality system standards of TNI/DoD. Findings, which indicate non-compliance or deviation from the LQSM, are flagged for corrective action. Corrective actions require either a return to compliance or a plan change to reflect an improved quality process. The QA Officer is responsible for making and documenting changes to the LQSM. These changes are reviewed by the Laboratory Director and Technical Director prior to the approval of the revised system.

Quality System Audits. Quality system audits are conducted to evaluate the effectiveness and laboratory compliance with individual quality system elements. These audits are conducted on an established schedule. Audit findings are documented and communicated to the management staff and entered into the corrective action system for resolution. If necessary, retraining is conducted to assure complete understanding of the system requirements.

Technical Compliance Audits. Technical compliance audits are performed throughout the year following the established schedule. Selected analytical procedures are evaluated for compliance with standard operating procedures (SOPs) and method requirements. If non-conformances exist, the published method serves as the standard for compliance. SOPs are edited for compliance if the document does not reflect method requirements. Analysts are trained to the new requirements and the process is monitored by quality assurance. Analysts are retrained in method procedures if an evaluation of bench practices indicates non-compliance with SOP requirements.

Documentation Audits. Documentation audits are conducted periodically. This audit includes a check of measurement processes that require manual documentation and non-analytical logbook review. It also includes checks of data archiving systems and a search to find and remove any inactive versions of SOPs that may still be present in the laboratory and being accessed by the analysts. Non-conformances are corrected on the spot. Procedural modifications are implemented if the evaluation indicates a systematic defect.

Corrective Action Monitoring. Defects or non-conformances that are identified during client or internal audits are shared with management and entered into CA database for attention by the responsible party. Audit findings are corrected through process modifications and/or retraining. Once a corrective action has been designed and implemented, it is monitored for compliance on a regular basis by the QA staff. Monitoring of the corrective action continues until satisfactory implementation has been verified.

Preventive Action. Laboratory systems or processes, which may be faulty and pose the potential for nonconformances, errors, confusing reports or difficulties establishing traceability may be identified during internal audits. These items are highlighted for systematic change using the corrective action system and managed to resolution using appropriate procedures for corrective action.

Client Notification. Defective processes, systematic errors, and quality defects detected during routine audits may have negative impact on data quality. In some cases, data that has been released to the client may be affected. If defective data has been released for use, SGS - Orlando will immediately notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

Management Reports. Formal reports of all audit activities are prepared for the management staff. These reports are prepared annually. The report details the status of the Quality System.

The formal report also addresses the following topics:

- *the suitability of policies and procedures;*
- *reports from managerial and supervisory personnel;*
- *the outcome of recent internal audits;*
- *corrective and preventive actions;*
- *assessments by external bodies;*
- *the results of inter-laboratory comparisons or proficiency tests;*
- *changes in the volume and type of the work;*
- *customer feedback;*
- *complaints;*
- *recommendations for improvement;*
- *other relevant factors, such as quality control activities, resources, and staff training.*

19.0 HEALTH AND SAFETY

Requirement. The company operates a formal health and safety program that complies with the requirements of the Occupational Health and Safety Administration. The program consists of key policies and practices that are essential to safe laboratory operation. All employees are required to receive training on the program elements. Job specific training is conducted to assure safe practices for specific tasks. All employees are required to participate in the program, receive initial and annual training, and comply with the program requirements. All plan and program requirements are detailed in the Health and Safety Program Manual.

19.1 **Policy.** SGS - Orlando will provide a safe and healthy working environment for its employees and clients while protecting the public and preserving the Company's assets and property. The company will comply with all applicable government regulations pertaining to safety and health in the laboratory and the workplace.

The objective of the SGS - Orlando Health and Safety Program is to promote safe work practices that minimize the occurrence of injuries and illness to the staff through proper health and safety training, correct laboratory technique application and the use of engineering controls.

19.2 **Responsibilities.** The Health and Safety Program assists managers, supervisors and non-supervisory employees in control of hazards and risks to minimize the potential for employee and client injuries, damage to client's property and damage or destruction to SGS - Orlando's facilities.

The Health and Safety Officer is responsible for implementing the Program's elements and updating its contents as necessary. He also conducts periodic audits to monitor compliance and assess the program's effectiveness and is also responsible for creating and administering safety training for all new and existing employees.

The employee is responsible for following all safety rules established for their protection, the protection of others and the proper use of protective devices provided by the Company. The employee is also expected to comply with the requirements of the program at all times. Department Managers and Supervisors are responsible for ensuring the requirements of the Safety Program are practiced daily. The Company President retains the ultimate responsibility for the program design and implementation.

19.3 **Program Elements.** The SGS - Orlando Health and Safety Program consists of key program elements that compliment the company's health and safety objective. These elements form the essence of the health and safety policy and assure that the objectives of the program are achieved.

Safety Education and Training and Communication. Training is conducted to increase the staff's awareness of laboratory hazards and their knowledge of the safety practices and procedures required to protect them from those hazards. It is also used to communicate general safety procedures required for safe operation in a chemical laboratory.

Initial health and safety training for new employees is conducted during new employee orientation and administered through SGS - Orlando University database.. The training focuses on the SGS - Orlando Safety and Health Program and includes specific training for the hazards that may be associated with the employees' duties. Training is also conducted for all program elements focusing on general, acceptable, laboratory safety procedures. Targeted training is conducted to address hazards or safety procedures that are specific to individual employee's work assignments. All training activities are documented and archived in individual training folders. A health and safety training inventory is maintained in the training database.

SGS - Orlando maintains personnel trained in HAZWOPER, DOT and HazMat operations, as well as respirator fit certification.

Safety Officer. The safety officer provides the employees with an opportunity to express their views and concerns on safety issues in an environment where those concerns will be addressed to ensure that the interests of the company and the well being of the employee are protected. Safety Officer is entrusted with elevating the level of safety awareness among their peers.

***Hazard Identification and Communication*.** The hazard communication program enables employees to readily identify laboratory hazards and the procedures to protect themselves from those hazards. This program complies with OSHA's Hazard Communication Standard, Title 29 Code of Federal Regulations 1910.1200 that requires the company to adopt and adhere to the following key elements:

- Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS) must be available to any employee wishing to view them,
- The Company must maintain a Hazardous Chemicals Inventory (by location), which is updated on an annual basis,
- Containers are properly labeled,
- All employees must be provided with annual Personal Protection, Hazard Communication and Right to Know training,

Chemical Hygiene Plan. The Chemical Hygiene Plan complies with the requirements of the Occupational Safety and Health Administration's Occupational Exposure to Hazardous Chemicals in the Laboratory Standard, 29 CFR 1910.1450. This plan establishes procedures, identifies safety equipment, personal protective equipment, and work practices that protect employees from the potential health hazards presented by hazardous chemicals in the laboratory if properly used and/or applied.

Emergency Action & Evacuation Plan. The Emergency Action and Evacuation Plan details the procedures used to protect and safeguard SGS - Orlando employees and property during emergencies. Emergencies are defined as fires or explosions, gas leaks, building collapse, hazardous material spills, emergencies that immediately threaten life and health, bomb threats and natural disasters such as floods, hurricanes or tornadoes. The plan identifies and assigns responsibility for executing specific roles in situations requiring emergency action.

Lockout/Tagout Plan. Lockout/tagout procedures have been established to assure that laboratory employees and outside contractors take steps to render equipment inoperable and/or safe before conducting maintenance activities. The plan details the procedures for conducting maintenance on equipment that has the potential to unexpectedly energize, start up, or release energy or can be operated unexpectedly or accidentally resulting in serious injury to employees. The plan ensures that employees performing maintenance render the equipment safe through lock out or tag out procedures.

Personal Protection Policy. Policies have been implemented which detail the personal protection requirements for employees. The policy includes specifications regarding engineering controls, personal protective equipment (PPE), hazardous waste, chemical exposures, working with chemicals and safe work practices. Safety requirements specific to processes or equipment are reviewed with the department supervisor or the Health and Safety Officer before beginning operations.

Emergency Preparedness Plan. This plan identifies the actions to be taken by SGS - Orlando staff in the event of terrorism or terrorist actions, to ensure the safety of the employees and the facility. The plan describes the building security actions coinciding with the “Alert Condition”, designated by the Department of Homeland Security.

Appendix I

Glossary of Terms

GLOSSARY OF TERMS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of TNI program, this process is a voluntary one.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity.

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality-system matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Case Narrative: a statement of non-conformances associated with particular data report

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

Calibration Curve: the mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Method: a defined technical procedure for performing a calibration.

Calibration Standard: a substance or reference material used to calibrate an instrument.

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.

Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples.

Clean Air Act: the enabling legislation in 42 U.S.C. 7401 *et seq.*, Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and to enforce them.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): the enabling legislation in 42 U.S.C. 9601-9675 *et seq*., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601*et seq.*, to eliminate the health and environmental threats posed by hazardous waste sites.

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors or, additional cleanup procedures.

Conformance: an affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Environmental Health and Safety (EHS) – SGS North America line of business to which SGS – Orlando laboratory belongs.

Federal Water Pollution Control Act (Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 *et seq.*, Public Law 92-50086 Stat. 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance.

Field of Testing: TNI's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required submit to only that portion of the accreditation process not previously addressed (see TNI, section 1.9ff).

Holding Times (Maximum Allowable Holding Times) the maximum times that samples may be held prior to analysis and still be considered valid or not compromised.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Matrix (or Quality System Matrix): the component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other leachates.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source. Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake. Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue, Biota: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Matrix Spike (spiked sample or fortified sample): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce’s Technology Administration that is working with EPA, States, TNI, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater.

The NELAC institute (TNI): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories.

TNI Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the The NELAC Institute.

Performance Audit: the routine comparison of independently obtained *qualitative and quantitative* measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

PT Fields of Testing: TNI's approach to offering proficiency testing by regulatory or environmental program, matrix type, and analyte.

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Manual: a document stating the management policies, objectives, principles, oganizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Quantitation Limits: the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

Range: the difference between the minimum and the maximum of a set of values.

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank or method blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

Requirement: denotes a mandatory specification; often designated by the term “shall”.

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 *et seq.* (1976), that gives EPA the authority to control hazardous waste from the “Cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal.

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f *et seq.* (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations.

Sample Duplicate: two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner.

Duplicate samples are used to assess variance of the total method including sampling and analysis.

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: the document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of TNI and meets the approval requirements of TNI procedures and policies.

Toxic Substances Control Act (TSCA): the enabling legislation in 15 USC 2601 *et seq.*, (1976), that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture.

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

United States Environmental Protection Agency (EPA): federal governmental agency with the responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends.

Validation: the process of substantiating specified performance criteria.

Verification: confirmation by examination and provision of evidence that specified requirements have been met.

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Appendix II

Analytical Capabilities

TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Organics		
EDB and DBCP	EPA 504.1	Drinking Water
Perfluorinated Carboxylic Acids and Sulfonates	EPA 537	Drinking Water
	Organics	
EDB and DBCP	EPA 504, SW846 8011**	Non-Potable Water
Volatile Organics	EPA 624**, SW846 8260B**, 8260B SIM**, 8260C**, 8260C SIM**, 8260D**, 8260D SIM**	Non-Potable Water
Semi-Volatile Organics	EPA 625**, SW846 8270D**	Non-Potable Water
Semi-Volatile Organics	SW846 8270D SIM**, 8270E**, 8270E** SIM	Non-Potable Water
Chlorinated Pesticides & PCBs	EPA 608**, SW846 8081B**, 8082A**	Non-Potable Water
Poly-Aromatic Hydrocarbons	EPA 610**	Non-Potable Water
Explosives	SW846 8330A**, 8332**	Non-Potable Water
Explosives	SW846 8330B**,	Non-Potable Water
Chlorinated Herbicides	SW846 8151A**	Non-Potable Water
Organophosphorus Pesticides	SW846 8141B**	Non-Potable Water
Perchlorate	SW846 6850**	Non-Potable Water
Perfluorinated Carboxylic Acids and Sulfonates	EPA 537 MOD** (ALS MS014)	Non-Potable Water
Dissolved Gases	RSK SOP 147-175**	Non-Potable Water
Alcohols	SW846 8015C**,8015D**	Non-Potable Water
Gasoline Range Organics	SW846 8015C**,8015D**	Non-Potable Water
Diesel Range Organics	SW846 8015C**,8015D**	Non-Potable Water
Total Petroleum Hydrocarbons	FLPRO**	Non-Potable Water
Tennessee EPH	TN-EPH**	Non-Potable Water
Tennessee GRO	TN-GRO**	Non-Potable Water
Wisconsin DRO	WI-DRO**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-1**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-2**	Non-Potable Water
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Non-Potable Water
Extractable Petro. Hydrocarbons	Massachusetts EPH, 2004**	Non-Potable Water
Acrylamide	SW846 8316	Non-Potable Water

Method Type	Method Number	Regulatory Program
Metals		
ICP: General – EPA WW	EPA 200.7**, 1994; SW-846 6010C**6010D**	Non-Potable Water
ICP/MS: General – EPA WW	EPA 200.8**, 1994; SW-846 6020A**, 6020B**	Non-Potable Water
Cold Vapor Mercury – EPA WW	EPA 245.1, 1994; SW-846 7470A**	Non-Potable Water
Inorganic WetChem		
Alkalinity	SM2320B-11**	Non-Potable Water
CBOD	SM5210B-11	Non-Potable Water
COD	SM5220C-11	Non-Potable Water
BOD	SM5210B-11	Non-Potable Water
Color, Apparent	SM2120B-11	Non-Potable Water
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	EPA 300.0**, SW846 9056A**	Non-Potable Water
Nitrate/Nitrite	EPA 353.2**	Non-Potable Water
Total Kjeldahl Nitrogen	EPA 351.2**	Non-Potable Water
Ammonia	EPA 350.1**	Non-Potable Water
Oil & Grease, Gravimetric – AQ	EPA 1664A**, 1664B, SW846 9070A**	Non-Potable Water
Orthophosphate	EPA 365.3**	Non-Potable Water
pH by electrode (Waters)	SM4500H+B-11**; SW846 9040C**	Non-Potable Water
Specific Conductance	EPA 120.1**	Non-Potable Water
Sulfide	SM4500S=F-11**	Non-Potable Water
Total Dissolved Solids	SM2540C-11**	Non-Potable Water
Total Organic Carbon	SM5310B-11, SW846 9060A**	Non-Potable Water
Total Phosphorus	EPA 365.3**	Non-Potable Water
Total Solids	SM2540B-11**	Non-Potable Water
Total Suspended Solids	SM2540D-11**	Non-Potable Water
Turbidity	EPA 180.1	Non-Potable Water
Total CN	EPA 335.4, SW846 9012B**	Non-Potable Water
Un-Ionized Ammonia - calculation	FDEP SOP10/03/83	Non-Potable Water
Calcium Hardness by Calculation	SM2340B-11	Non-Potable Water
Hardness, Total by Calculation	SM2340B-11	Non-Potable Water

Method Type	Method Number	Regulatory Program
Corrosivity & pH – aqueous	SW846 9040C**	Non-Potable Water
Hexavalent Chromium	SW846 7196A**	Non-Potable Water
Organics		
EDB and DBCP	SW846 8011 Mod**	Solid and Chemical Material
Volatile Organics	SW846 8260B**, 8260B SIM, 8260C**, 8260C SIM**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D**, 8270E**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D SIM**, 8270E SIM**	Solid and Chemical Material
Gasoline Range Organics	SW846 8015C**,8015D**	Solid and Chemical Material
Diesel Range Organics	SW846 8015C**,8015D**	Solid and Chemical Material
Alcohols	SW846 8015C**,8015D**	Solid and Chemical Material
Explosives	SW846 8330A**, 8332**	Solid and Chemical Material
Explosives	SW846 8330B**	Solid and Chemical Material
Organochlorine Pesticides	SW846 8081B**	Solid and Chemical Material
Polychlorinated Biphenyls	SW846 8082A**	Solid and Chemical Material
Chlorinated Herbicides	SW846 8151A**	Solid and Chemical Material
Organophosphorus Pesticides	SW846 8141B**	Solid and Chemical Material
Perchlorate	SW-846 6850**	Solid and Chemical Material
Perfluorinated Carboxylic Acids and Sulfonates	EPA 537 MOD** (ALS MS014)	Solid and Chemical Material
Total Petroleum Hydrocarbons	FLPRO**	Solid and Chemical Material
Tennessee EPH	TN-EPH**	Solid and Chemical Material
Tennessee GRO	TN-GRO**	Solid and Chemical Material
Wisconsin DRO	WI-DRO**	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Petroleum Hydrocarbons	Iowa OA-1**	Solid and Chemical Material
Petroleum Hydrocarbons	Iowa OA-2**	Solid and Chemical Material
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Solid and Chemical Material
Extractable Petro. Hydrocarbons	Massachusetts EPH, 2004**	Solid and Chemical Material
Acrylamide	SW846 8316	Solid and Chemical Material
Metals		
ICP: General	SW846 6010C**, 6010D**	Solid and Chemical Material
ICP/MS: General	SW846 6020A**, 6020B**	Solid and Chemical Material
Cold Vapor Mercury	SW846 7471B**	Solid and Chemical Material
Inorganic WetChem		
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	SW846 9056A**	Solid and Chemical Material
Total CN	SW846 9012B**	Solid and Chemical Material
Ammonia	EPA 350.1	Solid and Chemical Material
Total Kjeldahl Nitrogen	EPA 351.2	Solid and Chemical Material
Total Phosphorus	EPA 365.3	Solid and Chemical Material
Waste Ignitability	SW846 1010A**	Solid and Chemical Material
Hexavalent Chromium	SW846 7196A**	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C**	Solid and Chemical Material
Corrosivity & pH – solid	SW846 9045D**	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Cyanide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Sulfide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Organics		
Volatile Organics	TO-3	Air and Emissions
Preparation Methods*		
Liquid/Liquid Extraction, Water	SW846 3510C	
Micro-extraction, Water	SW846 3511	
Solid Phase Extraction, Water	SW846 3535A	
Solids Extraction by Sonication	SW846 3550B	
Microwave-assisted extraction, solids	SW846 3546	
Acid/Base Partitioning	SW846 3650B	
Sulfur Cleanup of Extracts	SW846 3660B	
Sulfuric Acid Cleanup	SW846 3665A	
Purge & Trap - Aqueous	SW846 5030B	
Purge & Trap – Solids	SW846 5035A	
Total Recoverable Metals Digestion	EPA 200.7, 200.8	
Non-Pot. Water Digest: ICP	SW846 3010A	
Alkaline Digestion of Soils for Hexavalent Chromium	SW846 3060A	
Digestion of Soils for ICP	SW846 3050B	
TCLP	SW846 1311	
SPLP	SW846 1312	

* Preparation methods are not listed on Primary TNI Accreditation per State of Florida DOH rules. However, for the benefit of other accrediting authorities, these methods are inspected during FDOH visits. Listing of surveyed and approved preparation methods is available from on-site inspection report.
** Methods certified by DoD ELAP

Non-TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Thiodiglycol	SGS - Orlando in-house method (HPLC)	Non-Potable Water, Solid and Chemical Material
Perfluorinated Carboxylic Acids and Sulfonates	DoD QSM 5.1 table B-15 compliant**	Non-Potable Water, Solid and Chemical Material
Volatile Organics	SM6200B-11	Non-Potable Water
Volatile Petroleum Hydrocarbons	Missouri Gasoline Range Organics	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	Missouri Diesel Range Organics	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	Missouri Oil Range Organic	Non-Potable Water, Solid and Chemical Material
Volatile Petroleum Hydrocarbons	KS-LRH**	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	KS-MRH**, KS-HRH**	Non-Potable Water, Solid and Chemical Material
Volatile Petroleum Hydrocarbons	NW-TPH	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	NW-TPH	Non-Potable Water, Solid and Chemical Material
Volatile Petroleum Hydrocarbons	Alaska AK-101**	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-102**	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-103**	Non-Potable Water, Solid and Chemical Material
Volatile Petroleum Hydrocarbons	OK GRO**	Non-Potable Water, Solid and Chemical Material
Extractable Hydrocarbons	OK DRO**	Non-Potable Water,

Method Type	Method Number	Regulatory Program
		Solid and Chemical Material
Inorganic WetChem		
Percent Ash (dry basis)	ASTM D2974-87, D482-91	Solid and Chemical Material
Sieve Testing	ASTM D422-63	Solid and Chemical Material
Dissolved Oxygen	EPA 360.1	Non-Potable Water
Mineral Suspended Solids	EPA 160.2/160.4	Non-Potable Water
Oil & Grease, Gravimetric – AQ	EPA 1664B	Non-Potable Water
Percent Solids	SM2540G-11	Solid and Chemical Material
Settleable Solids	EPA 160.5	Non-Potable Water
Total Mineral Solids	EPA 160.4	Non-Potable Water
Total Residual Chlorine	EPA 330.5	Non-Potable Water
Total Volatile Solids	EPA 160.4	Non-Potable Water
Volatile Suspended Solids	EPA 160.2/160.4	Non-Potable Water
CN□ Amenable to Chlorination	EPA 335.4	Solid and Chemical Material
Bicarbonate, Carbonate, CO2 - calculation	SM2320B-11, SM4500 CO2D-11	Non-Potable Water
Ferrous Iron	SM3500 FE-D-11	Non-Potable Water
Salinity - calculation	SM2520B-11	Non-Potable Water
Paint Filter Test	SW846 9095	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C	Solid and Chemical Material

Appendix III

Equipment List

Instrument	Model	Location	Serial #	Year
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US13042A19	2013
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US11172705	2011
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US11322911	2011
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US11282930	2011
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US10102029	2010
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US10452710	2010
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US83120965	2008
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US71225975	2007
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US62724401	2006
GC/MS	Agilent 5975TAD MSD/OI 4551/4660	MS-VOA	US62733661	2006
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US53921303	2005
GC/MS	Agilent 5973N MSD/Agilent 7683 AS	SVOC Lab	US40620599	2004
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US41746628	2004
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US41746633	2004
GC/MS	Agilent 5973 MSD/OI 4560/4552 Archon	Soil VOA	US21843765	2002
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US21844034	2002
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	Soil VOA	US02440350	2000
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US94240108	1999
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US82311290	1998
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US81211109	1998
GC/MS	Agilent 5973A MSD/OI 4660/4552 Archon	Soil VOA	US82321728	1998
GC/MS	Agilent 5973A MSD/OI 4660/4551	MS-VOA	US63810329	1996
GC	Agilent 7890A/Dual FID/7693 AS	SVOC Lab	CN13161042	2013
GC	Agilent 7890A/Dual FID/7683B AS	SVOC Lab	CN12121006	2012
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10842133	2008

Instrument	Model	Location	Serial #	Year
GC	Agilent 7890A/Dual FID/7693 AS	SVOC Lab	CN10902149	2009
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10741128	2007
GC	Agilent 6890/Dual FPD/7683B AS	SVOC Lab	US10643024	2006
GC	Agilent 6890/Dual FID/7683B AS	SVOC Lab	CN10641049	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	CN10641081	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	US10613003	2006
GC	Agilent 6890/PID/PID/OI 4560/4552 Archon	GC VOA	CN10421047	2004
GC	Agilent 6890/PID/FID/ENTECH 7032A-LB	GC VOA	US10239007	2002
GC	Agilent 6890N/Dual FID/HP 7683 AS	SVOC Lab	CN10425061	2004
GC	Agilent 6890N/Dual ECD/HP 7683 AS	SVOC Lab	US10333015	2003
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00036916	2000
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00028304	1999
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A60617	1993
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	Soil VOA	3336A61096	1993
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A51045	1993
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon	GC VOA	3203A41646	1992
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon (screening instrument)	GC VOA	3223A42867	1992
GC	Hewlett-Packard 5890/PID/FID OI 4560/4552 Archon	Soil VOA	3029A29748	1990
GC	Hewlett-Packard 5890/FID	GC VOA	2843A20183	1988
GC	Hewlett-Packard 5890/FID	GC VOA	2728A12705	1987
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE91606857	1999
HPLC	Agilent 1100 Automated LC System	HPLC Room		2002

Instrument	Model	Location	Serial #	Year
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE01608404	2000
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE40522115	2004
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE03000863	2003
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE61800775	2006
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE33219455	2003
LC/MS/MS	Agilent 1200/6460 LC/Triple Quad	HPLC Room	SG10447001	2011
LC/MS/MS	Agilent 1200/6460 LC/Triple Quad	HPLC Room	SG163G008	2016
O-Prep	ESSA LM2-P Ring and Puck mill	Explosives Prep Lab	215090-004	2008
O-prep	Microwave extractor MARS 6, 2 units	Organic Prep Lab	Multiple	Various
O-Prep	TurboVap concentrators, 8 units	Organic Prep Lab	Multiple	Various
O-Prep	Buchi solvent recovery system, 4 units	Organic Prep Lab	Multiple	2014
O-Prep	Sonicator 4 units	Organic Prep Lab		Various
O-Prep	N-Vap	Organic Prep Lab	479200-2000	2000
Data System	Hewlett-Packard/MS ChemStation	Labwide		1999, with subsequent upgrades

Instrument	Model	Location	Serial #	Year
ICP/MS	Agilent 7700 Series	Metals Lab	JP12151709	2012
ICP	Thermo ICAP 6000 Series	Metals Lab	20100903	2010
ICP	Thermo ICAP 6000 Series	Metals Lab	20103825	2010
Mercury Analyzer	Leeman Hydra AA II	Metals Lab	2019	2012
Mercury Analyzer	Leeman Hydra AA II	Metals Lab	2004	2012
TOC Analyzer	Teledyne TORCH	VOC GC Room	US18151009	2019

Instrument	Model	Location	Serial #	Year
TOC Analyzer	Shimadzu	VOC GC room	H51404735099	2010
IC	Dionex IC-2100	VOC MS room	1930200035126	2019
IC	Dionex IC-2000	WetChem IC room	04070250	2004
Auto Analyzer	QuickChem 8500 Series	WetChem main room	050500000130	2005
Auto Analyzer	QuickChem 8500 Series 2	WetChem main room	111200001380	2011
Spectrophotometer	Milton-Roy Spectronic 200	WetChem main room	2 units	2000
Digestion block	DigiPrep	WetChem main room	2units	2005
Digestion block	DigiPrep	WetChem main room	2 units	2018
Centrifuge	CentraCL2	WetChem main room	42613052	2003
Autoclave	ThermoFisher NAPCO	WetChem IC room	124977-418	2015
MicroDistillation Block	Lachat	WetChem main room	2 units	2005

LIMS

Instrument	Model	Year
LIMS	Stratus Dual Server; Oracle 10G Database	2013

Appendix IV

Certification Summary

Alaska	Contaminated Sites	UST-088
Arizona	Solid/Hazardous Waste	
Arkansas	Solid/Hazardous Wastes, Non-Potable Water	88-0620
		04226CA
Department of Defense (DoD)	Non-Potable Water, Solid and Chemical Materials	L-2229
Florida (NELAP)	Potable, Non-Potable, Solid Waste, UST, Air Toxics	E83510
Georgia	Wastewater/Microbiology analyst	Not Applicable
Illinois	Solid/Hazardous Wastes, Non-Potable Water	
Iowa	UST, Solid/Hazardous Wastes, Non-Potable Water	IA366
Kansas (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	E-10327
Kentucky	Underground Storage Tank Program	0065
Kentucky		98023
Louisiana (NELAP)	Solid/Hazardous Wastes	38582
Massachusetts	Non-Potable Water	M-FL946
Mississippi	Potable Water	Not Applicable
Nevada	Non-Potable Water, Solid/Hazardous Wastes	FL009462008A
New Hampshire	Non-Potable Water, Solid/Hazardous Wastes	
New Jersey (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	FL002
New York	Solid/Hazardous Wastes, Non-Potable Water	12022
North Carolina	Solid/Hazardous Wastes, Non-Potable Water	573
North Dakota	Solid/Hazardous Wastes, Non-Potable Water	
Oklahoma	Non-Potable Water, Solid/Hazardous Waste	9959
Oregon	Non-Potable Water, Solid/Hazardous Waste	
South Carolina	Solid/Hazardous Wastes, Non-Potable Water	96038001
Texas (NELAP)	Non-Potable Water, Solid/Hazardous Waste	T104704040-08-TX
US Dept. of Agriculture	Foreign Soils Permit	P330-16-00126
Utah (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	FL009462008A
Virginia (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	460177
Washington	Potable, Non-Potable, Solid/Chemical Materials, Air	C2046
West Virginia	Solid/Hazardous Wastes, Non-Potable Water	304

Appendix V

SOP List

SOP #	TITLE
	Organic Preparation Department
OP002	SOP for Glassware Cleaning and Storage
OP003	SOP for Reagent Prep
OP006	SOP for the Extraction of Semi-volatile Organics (BNAs) from Aqueous Samples
OP007	SOP for the Extraction of Semi-volatile Organics (BNAs) from Solid Samples
OP007TV	SOP for the Extraction of Semi-volatile Organics (BNAs) from Solid Samples, TurboVap option
OP008	SOP for the Extraction of Pesticides/PCBs from Aqueous Samples
OP009	SOP for the Extraction of Pesticides/PCBs from Solid Samples
OP009MW	SOP for the Extraction of Pesticides/PCBs from Solid Samples, microwave
OP010	SOP for the Extraction of Diesel Range Organics (DRO) from Aqueous Samples
OP011	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP011MW	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP012	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Aqueous Samples
OP013	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Solid Samples
OP014	SOP for the Extraction of PAHs from Aqueous Samples (HPLC)
OP015	SOP for the Extraction of PAHs from Solid Samples (HPLC)
OP016	SOP for the Extraction of EDB/DBCP from Aqueous Samples
OP017	SOP for the Extraction of EDB/DBCP from Solid Samples
OP018	SOP for the Extraction of Explosives from Aqueous Samples, 8330A/B
OP019	SOP for the Extraction of Explosives from Solid Samples, 8330A
OP020	SOP for Sample Introduction via SW846-5035
OP021	SOP for Sample Introduction via SW846-5030B
OP024	Standard Operating Procedure For The Extraction Of Nitroaromatics From Water Samples
OP025	SOP For Sample Preparation For Dissolved Gases In Aqueous Samples
OP026	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Water Samples
OP027	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Solid Samples
OP028	SOP For The Extraction Of Diesel And Oil Range Organics From Water Samples
OP029	SOP For The Extraction Of Diesel And Oil Range Organics From Solid Samples
OP030	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From Water Samples (Tennessee EPH)

SOP #	TITLE
OP031	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From Solid Samples (Tennessee EPH)
OP032	SOP For The Extraction Of Volatile Petroleum Hydrocarbons From Soil Samples, MA-VPH
OP033	SOP For The Extraction Of PCBs From Wipes
OP034	SOP For The Extraction Of Diesel Range Organics (DRO) From Aqueous Samples WI-DRO
OP035	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Water Samples
OP036MW	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Solid Samples, Microwave option
OP037	SOP For The Extraction Of Chlorinated Herbicides From Water Samples
OP038MW	SOP For The Extraction Of Chlorinated Herbicides From Soil Samples, microwave
OP039	SOP For The Solid Phase Extraction (SPE) Cartridge Cleanup Of Pesticide Extracts
OP040	SOP For SPLP Leaching Of SVOC And Metals
OP041	SOP For TCLP Leaching Of VOC
OP042	SOP For SPLP Leaching Of SVOC And Metals
OP043	SOP For SPLP Leaching Of VOC
OP044	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples
OP044SP	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples, Solid Phase Extraction
OP045MW	SOP For The Extraction Of Organophosphorus Pesticides From Soil Samples, microwave
OP046	SOP for the Extraction of Explosives from Solid Samples, SW-8330B
OP048	SOP for the Extraction of PCB Congeners from Aqueous Samples
OP049	SOP for the Extraction of PCB Congeners from Solid Samples
OP050	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Water Samples
OP051	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Solid Samples
OP052	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Water Samples
OP053	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Solid Samples
OP054	SOP For The Extraction Of 1,4-Dioxane From Water Samples
OP055	SOP For The Extraction Of Petroleum Hydrocarbons From Water Samples, TX-1005
OP056	SOP For The Extraction Of Petroleum Hydrocarbons From Solid Samples, TX-1005
OP057	SOP for Sample Introduction via AK-101
OP058	SOP For Extraction Perfluorinated Alkyl Compounds From Water Samples

SOP #	TITLE
OP059	SOP for Extraction of PAH and select analytes for 8270 SIM analysis from Aqueous samples
OP060	SOP for Extraction of PAH and select analytes for 8270 SIM analysis from Solid samples
OP061	SOP for Reduced Volume Extraction of PAH from water sample for GC/MS LVI
OP062	SOP for microextraction of PAH from water samples 3511.

Gas Chromatography/ HPLC SOPs

GC002	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector
GC005	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector EPA 608
GC006	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector EPA 608
GC007	Analysis Of Polynuclear Aromatic Hydrocarbons By Gas Chromatography, Flame Ionization Detector EPA 610
GC008	Analysis Of Petroleum Range Organics By Gas Chromatography Using Flame Ionization Detector
GC009	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector SW-846 8011
GC010	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector
GC011	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector
GC014	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector SW-846 8082
GC015	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector SW-846 8081
GC016	Analysis Of Nitroaromatics And Nitramines By HPLC
GC019	Analysis Of Dissolved Gases By Gas Chromatography, Flame Ionization Detector
GC020	Analysis Of Nitroglycerine And PETN By HPLC
GC021	Analysis Of Volatile Petroleum Hydrocarbons By Gas Chromatography
GC022	Analysis Of Extractable Petroleum Products By Gas Chromatography Using Flame Ionization Detector OA-2
GC023	Analysis Of Diesel And Oil Range Organics By Gas Chromatography Using Flame Ionization Detector
GC024	Analysis Of Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector (Tennessee EPH)
GC025	Analysis Of Nitroaromatics By Gas Chromatography Using Electron Capture Detector
GC026	Method For Determination Of Volatile Petroleum Hydrocarbons By GC-

SOP #	TITLE
	PID/FID
GC027	Analysis Of Non-Halogenated Organics By Gas Chromatography Using Flame Ionization Detector
GC028	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector TDEC GRO
GC029	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector Wi DRO
GC030	Analysis Of Extractable Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector MA-EPH
GC031	Analysis Of Chlorinated Herbicides Using GC-ECD
GC032	Analysis Of Organophosphorus Pesticides Using GC-NPD Or FPD
GC033	Air Analysis By GC-PID/FID
GC034	Analysis Of Nitroaromatics, Nitramines And Nitrate Esters By HPLC Method 8330B
GC035	Screening Of Volatile Organics By GC-PID/FID
GC036	Analysis of PCB Congeners by ECD
GC037	Analysis of Diesel and Oil Range Organics by GC/FID, AK-102, AK-103
GC038	Analysis of Gasoline Range Organics by GC/FID, AK-101
GC039	Analysis of Diesel Range Organics by GC/FID, OK-GRO
GC040	Analysis of Gasoline Range Organics by GC/FID, OK-GRO
GC041	Analysis of N-Nitroso-N-Ethylurea by HPLC
GC042	Analysis of Thiodiglycol by HPLC
GC043	Analysis of Acrylamide by HPLC
GC044	Analysis of Petroleum Organics by TX-1005
GC045	Automated Fractionation of MA-EPH extracts
GC046	SOP for Screening Petroleum Range Organics by FID
GC047	Nitroguanidine by HPLC
GC048	Analysis of KS LRH by GC-FID
GC049	Analysis of KS MRH-HPH by GC-FID

Mass-Spectrometry SOPs

MS003	Analysis of Volatile Organics by EPA Method 624
MS004	Analysis of Semi-volatile Organics by EPA Method 625
MS005	Analysis of Volatile Organics by EPA Method 8260B
MS006	Analysis of Semi-volatile Organics by EPA Method 8270C
MS008	Analysis of Semi-volatile Organics by EPA Method 8270C SIM
MS009	Analysis of Volatile Organics by GC/MS
MS010	Analysis of Volatile Organics by GC/MS SIM
MS011	Analysis of Semi-volatile Organics by EPA Method 8270D
MS012	Analysis of 1,4-Dioxane by EPA 522
MS013	Analysis of Perchlorate by SW-846 6850
MS014	Analysis of PFOS/PFOA by LC/MS/MSD
MS015	Analysis of 8270 SIM LVI

SOP #	TITLE
MS016	Analysis of Volatile Organics by EPA Method 8260C
MS017	Analysis of PFOS/PFOA by LC/MS/MSD, method EPA 537, Drinking water
MS018	Analysis of Amines by LC/MS/MSD,
MS019	Analysis of PFOS/PFOA by LC/MS/MSD, Isotope Dilution

Quality Assurance SOPs

QA001	Preparation, Approval, Distribution & Archiving Of Standard Operating Procedures (SOPs)
QA002	Calibration Of Thermometers
QA003	Personnel Training And Analyst Proficiency
QA004	Temperature Monitoring
QA005	Calibration Of Analytical Balances
QA006	Eppendorf Pipette Calibration
QA007	Sample Batching Procedure
QA008	Creating New Accounts
QA009	Creating New Projects
QA010	Confidentiality Protection Procedures
QA011	Signature Authority
QA012	Employee Technical Ethics Responsibilities
QA013	Client Complaint Resolution Procedure
QA014	Procedures For The Purchase Of Laboratory Supplies
QA015	Procedures For The Preparation, Distribution, Use And Archiving Of Laboratory Logbooks
QA016	Corrective Action Procedure
QA017	Standards Traceability Documentation Procedure
QA018	Procedure For Login, Management, Handling, And Reporting Of Proficiency Test (Pt) Samples
QA019	Quality System Review
QA020	Procedure For Developing Method Performance Criteria And Experimental Method Detection Limits
QA021	Subcontracting Procedures
QA022	Internal Audit Procedure
QA023	Fume Hood Inspection
QA027	Review Of Inorganics Data
QA028	Review Of Organics Data
QA029	Manual Integration Of Chromatographic Peaks
QA030	Procedure For The Development And Use Of in-house Quality Control Criteria
QA031	Air Quality Monitoring Of Extraction Laboratory
QA032	Routine Maintenance For Major Analytical Instrumentation
QA033	Laboratory Safety
QA034	Sample Homogenizing
QA035	Solvent Testing And Approval

SOP #	**TITLE**
QA036	Data Package Generation
QA037	Deionized Water Quality Control Procedure
QA038	Data Integrity Training Procedure
QA039	Data Integrity Monitoring Procedure
QA040	Procedure For Conducting Data Integrity Investigations
QA041	Procedure For The Confidential Reporting Of Data Integrity Issues
QA042	Basic Calculations For General Chemistry Methods
QA043	Data Qualifier SOP
QA044	Calibration Of Micro-Distillation Tubes
QA045	Estimation of Uncertainty
QA046	Document Control
QA047	Management of Client Project
QA048	Data Entry for Log-In
QA049	MA DEP DW Notification
QA050	PA DW Notification

General Chemistry SOPs

GNSOP: 101	Acidity (pH 8.2)
GNSOP: 102	Alkalinity, Total (pH 4.5)
GNSOP: 103	Ammonia – Distillation Procedure
GNSOP: 104	Nitrogen, Ammonia
GNSOP: 104GD	Nitrogen, Ammonia, Gas Diffusion option
GNSOP: 105	Bicarbonate, Carbonate, Free Carbon Dioxide
GNSOP: 106	Chemical Oxygen Demand
GNSOP: 109	Color, Apparent
GNSOP: 110	Chromium, Hexavalent (Water)
GNSOP: 113	Cyanide Distillation/Aqueous And Solid Samples
GNSOP: 115	Cyanide, Total
GNSOP: 116	Dissolved Oxygen
GNSOP: 121	Ignitability
GNSOP: 123	Nitrogen, Nitrite
GNSOP: 126	Ortho Phosphate
GNSOP: 127	Paint Filter Liquids Test
GNSOP: 128	Phenols Distillation, Soil And Water Samples
GNSOP: 130	Phenols, Total Recoverable
GNSOP: 133	Settleable Solids
GNSOP: 134	Total Suspended Solids (Non Filterable Residue)
GNSOP: 135	Total Dissolved Solids (Total Filterable Residue)
GNSOP: 136	Reactive Sulfide And Reactive Cyanide
GNSOP: 137	pH By Electrode - Water
GNSOP: 140	Sulfide
GNSOP: 144	Total Phosphorus

SOP #	TITLE
GNSOP: 145	Turbidity
GNSOP: 147	Winkler Titration For DO Standardization
GNSOP: 161	Percent Solids
GNSOP: 163	Specific Conductance At 25 C.
GNSOP: 166	pH By Electrode – Soil
GNSOP: 167	Biochemical Oxygen Demand (BOD)
GNSOP: 171	Hexachromium In Soils
GNSOP: 179	Corrosivity (Soil pH By Electrode)
GNSOP: 182	Total Kjeldahl Nitrogen
GNSOP: 189	Corrosivity Toward Steel
GNSOP: 190	Total Nitrogen, Organic Nitrogen
GNSOP: 191	Nitrogen, Nitrate
GNSOP: 192	Carbonaceous Biochemical Oxygen Demand (CBOD)
GNSOP: 193	Oxidation-Reduction Potential
GNSOP: 194	Ferrous Iron
GNSOP: 196	Glassware Cleaning
GNSOP: 211	Oil & Grease And PHC By 1664
GNSOP: 212	Fractional Organic Carbon
GNSOP: 213	Walkley-Black Total Organic Carbon
GNSOP: 214	Particle Size By Sieve
GNSOP: 215	TOC In Water
GNSOP: 218	Perchlorate
GNSOP: 219	Bulk Density
GNSOP: 222	Un-Ionized Ammonia Calculation
GNSOP: 224	Hardness By Calculation
GNSOP: 225	Cation Exchange Capacity Of Soils (Sodium Acetate)
GNSOP: 226	TOC In Soil
GNSOP: 227	Oil And Grease – Gravimetric Analysis (Soils)
GNSOP: 228	Anions By Ion Chromatography
GNSOP: 231	% Ash
GNSOP: 232	Determination Of Nitrate and Nitrite by Lachat
GNSOP: 233	Sulfite
GNSOP: 234	Total Solids, Gravimetric
GNSOP: 235	Total Volatile Solids, Gravimetric

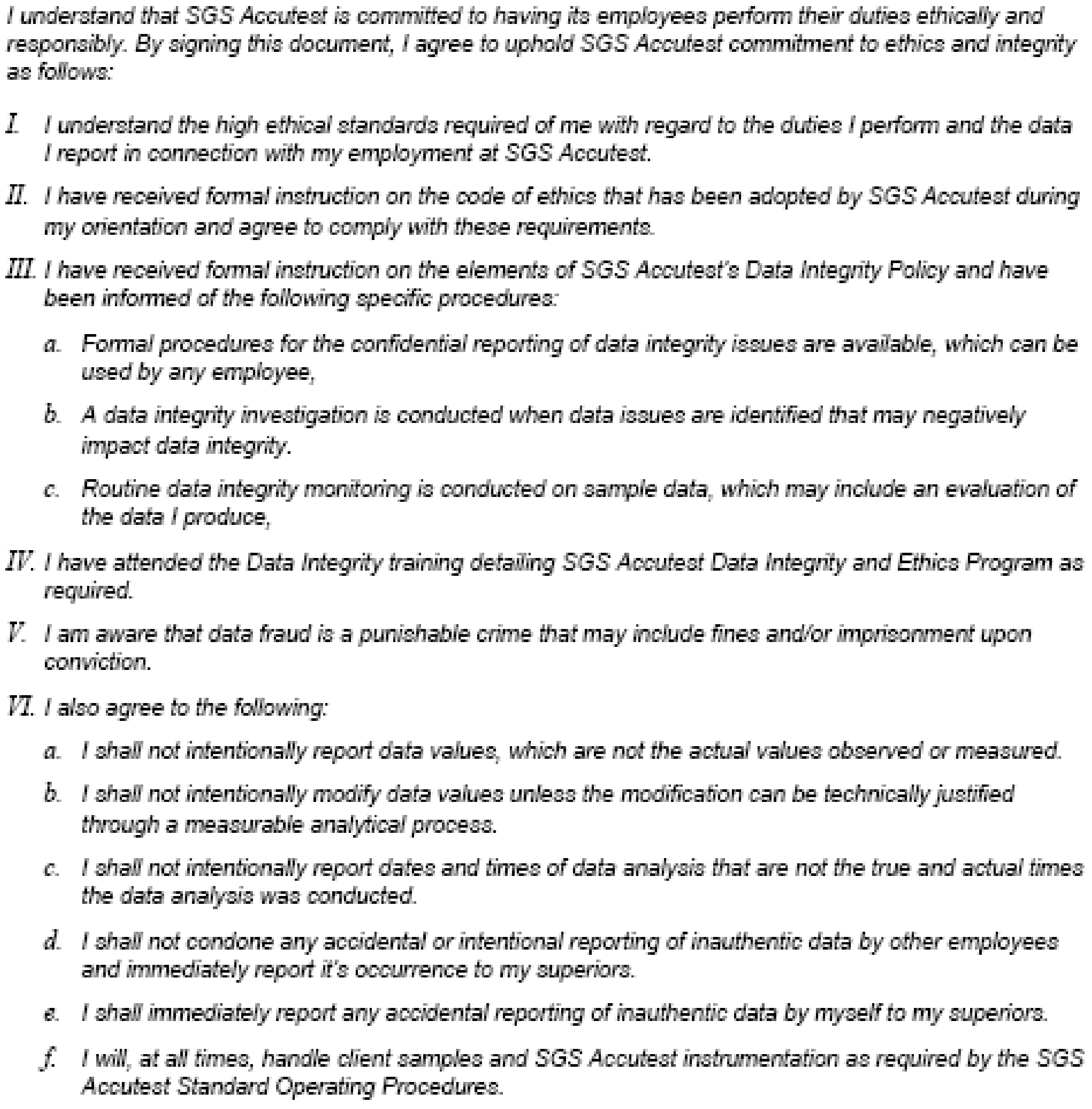
Metals SOPs

MET 100	Metals By Inductively Coupled Plasma, EPA 6010C
MET 103	Digestion Of Water Samples For Flame And ICP Analysis
MET 104	Digestion Of Soils For ICP Analysis
MET 105	Cold Vapor Analysis Of Mercury For Soils
MET 106	Cold Vapor Analysis Of Mercury For Water Samples
MET 107	Metals By Inductively Coupled Plasma, Mass-Spectrometry
MET 108	Metals By Inductively Coupled Plasma, EPA 6010D

SOP #	TITLE
	Sample Management SOPs
SAM101	Sample Receipt And Storage
SAM102	Procedure For Sample Bottle Preparation And Shipment
SAM104	Sample Container Quality Control
SAM108	Sample And Laboratory Waste Disposition
SAM109	Foreign Soil receipt and Handling

Appendix VI

Data Integrity Training Acknowledgement and Ethical Conduct Agreement



I understand that SGS Accutest is committed to having its employees perform their duties ethically and responsibly. By signing this document, I agree to uphold SGS Accutest commitment to ethics and integrity as follows:

I. I understand the high ethical standards required of me with regard to the duties I perform and the data I report in connection with my employment at SGS Accutest.

II. I have received formal instruction on the code of ethics that has been adopted by SGS Accutest during my orientation and agree to comply with these requirements.

III. I have received formal instruction on the elements of SGS Accutest's Data Integrity Policy and have been informed of the following specific procedures:

- *a. Formal procedures for the confidential reporting of data integrity issues are available, which can be used by any employee,*
- *b. A data integrity investigation is conducted when data issues are identified that may negatively impact data integrity.*
- *c. Routine data integrity monitoring is conducted on sample data, which may include an evaluation of the data I produce,*

IV. I have attended the Data Integrity training detailing SGS Accutest Data Integrity and Ethics Program as required.

V. I am aware that data fraud is a punishable crime that may include fines and/or imprisonment upon conviction.

VI. I also agree to the following:

- *a. I shall not intentionally report data values, which are not the actual values observed or measured.*
- *b. I shall not intentionally modify data values unless the modification can be technically justified through a measurable analytical process.*
- *c. I shall not intentionally report dates and times of data analysis that are not the true and actual times the data analysis was conducted.*
- *d. I shall not condone any accidental or intentional reporting of inauthentic data by other employees and immediately report it's occurrence to my superiors.*
- *e. I shall immediately report any accidental reporting of inauthentic data by myself to my superiors.*
- *f. I will, at all times, handle client samples and SGS Accutest instrumentation as required by the SGS Accutest Standard Operating Procedures.*

g. I will not intentionally deviate from, or fail to follow, the SGS Accutest Standard Operating Procedures at any time except as authorized by this document.

h. I understand that deviations from a Standard Operating procedure are allowed only when the deviations are clearly presented in writing by supervisory, managerial or director level staff and when those deviations do not contradict any part of the SGS Accutest ethics policy. No other personnel are allowed to approve Standard Operating Procedure deviations.

i. Anytime someone suggests, recommends, or requests that I do not follow an SGS Accutest Standard Operating Procedure, other than as noted in h above, I shall immediately notify my supervisor, manager, a Quality Assurance Officer, the Lab Director, or the Director of Human Resources.

j. Anytime I am uncomfortable or unsure about an action that I am requested to perform, I shall immediately notify my supervisor, manager, a Quality Assurance officer, the Lab Director, or the Director of Human Resources. By doing so, I understand that I will not be punished or penalized for asking for guidance or reporting potential wrongdoing.

k. If I intentionally disregard the SGS Accutest Standard Operating Procedures without written authorization to do so, I may face disciplinary action up to and including termination of my employment. Note: unintentional deviation from a Standard Operating Procedure must be documented on discovery and appropriate corrective actions followed.

l. If I become aware of another person who appears to be disregarding the SGS Accutest Standard Operating Procedures without written authorization to do so, I shall immediately report it to my supervisor, manager, a Quality Assurance Officer, the Lab Director, or the Director of Human Resources. By failing to do so, I may face disciplinary action up to and including termination of my employment.

m. I am aware that intentionally failing to follow an SGS Accutest Standard Operating Procedure, other than as noted in h above, may be illegal and could be considered data fraud. In addition, providing instruction to another person to deviate from a Standard Operation, other than as noted in c above, may be illegal and could be considered data fraud.

n. I am aware that data fraud is a crime and is punishable by fines and/or imprisonment upon conviction. It is the general policy of SGS Accutest to cooperate with law enforcement authorities in the investigation and prosecution of such matters.

o. I understand that SGS Accutest strictly prohibits unlawful retaliation and I understand that, if I report a violation of the SGS Accutest Standard Operating Procedures or an instruction that would violate the SGS Accutest Standard Operating Procedures, I will not be subjected in any way to any adverse employment action because of my report. I agree that if I believe I am being, or have been, subjected to an adverse employment action because of my report, then I will immediately notify my supervisor, manager, a Quality Assurance officer, the Lab Director, or the Director of Human Resources. I agree that SGS Accutest cannot address or correct any such retaliatory behavior unless it is reported and SGS Accutest is given an opportunity to address or correct such behavior.

Printed Name	Signature	Date

ANALYSIS OF NITROAROMATICS, NITRAMINES, AND NITRATE ESTERS BY HPLC METHOD SW-846 8330B

Prepared by: Norm Farmer Date: 10/14/19

Approved by: Mike Eger Date: 10/15/19

Annual Review

Reviewed by: ______ Date: ______

Reviewed by: ______ Date: ______

Reviewed by: ______ Date: ______

Document Control

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Issued to: SVOC Department Date: * 10/22/19

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Issued to: ______ Date: ______

Effective 7 days after "*" date

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TITLE: ANALYSIS OF NITROAROMATICS, NITRAMINES, AND NITRATE ESTERS BY HPLC METHOD SW-846 8330B

REFERENCES: SW846 8330B

REVISED SECTIONS: 1.1.7, 1.2.3, 7.2.1, 7.2.2, 7.4.1.1, 7.4.3.4, 7.4.3.5, 9.2.1.3, 9.2.2, 9.3.2.4 and 12.0

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific nitroaromatics, nitramines, and nitrate esters in water and solid matrices utilizing an HPLC equipped with a diode array detector.

1.1.2 The following compounds can be reported by this method:

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	
1,3-Dinitrobenzene	1,3,5-Trinitrobenzene
2,6-Dinitrotoluene	2,4,6-Trinitrotoluene
2,4-Dinitrotoluene	2,4-diamino-6-Nitrotoluene
2-amino-4,6-Dinitrotoluene	2,6-diamino-4-Nitrotoluene
4-amino-2,6-Dinitrotoluene	2-amino-6-Nitrotoluene
Nitrobenzene	2-amino-4-Nitrotoluene
o-Nitrotoluene	4-amino-2-Nitrotoluene
m-Nitrotoluene	2,4-Diaminotoluene
p-Nitrotoluene	2,6-Diaminotoluene
DNX	3,5-Dinitroaniline
MNX	Nitroglycerine
TNX	PETN

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are in the range of 0.2 to 2.0 ug/l for aqueous samples and 100 to 1000 ug/kg for solid samples.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ. Note: MDL verifications for 8330B soils must be spiked prior to grinding.

1.1.5 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.6 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the LLOQ be reported

1.1.7 For DOD projects refer to 5.0, Table 3; or QSM 5.x Table B-3 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from SW846 Method 8330B.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS – Orlando SOP OP018 and OP046.

1.2.4 The extracts are analyzed on an HPLC equipped with a diode array detector.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Aqueous samples shall be collected in amber glass bottles with Teflon lined caps. One-liter or 250ml bottles are recommended for aqueous samples.

2.1.2 Soil samples shall be collected by multi-incremental sampling or by the collection of large volume discreet samples. This can result in sample sizes of one to two kilograms. Samples shall be collected in heavy duty 1 or 2-gallon Ziplock bags. It is recommended that the samples be double bagged to prevent punctures.

2.1.3 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. Soil samples can be stored at room temperature after they have been air dried. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts should be analyzed as soon as possible but must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.3 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl should be diluted with acetonitrile prior to filtration and acidified to pH < 3. Samples and extracts should not be exposed to temperatures above room temperature.

3.4 High levels of 4-amino-2-nitrotoluene may interfere with the surrogate 3,4-dinitrotoluene on the (Zorbax Extend C-18) primary column. In such instances, the surrogate recovery should be calculated from the confirmation column.

3.5 3,5-dinitroaniline partially co-elutes with o-nitrotoluene and p-nitrotoluene on the confirmation column.

3.6 When analyzing the RDX breakdown analytes, TNX may partially coelute with HMX on the primary column and DNX may partially co-elute with HMX on the confirmation columns.

3.7 Samples from sites using alkaline hydrolysis to remediate explosives may have a high basic pH. These samples and extracts should be neutralized prior to analysis to prevent damage to the analytical column.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the LLOQ.

4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Proficiency Test Sample (PT): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The PT sample is generally prepared by an outside vendor. This method requires that the PT sample go through the entire preparatory procedure including sieving and grinding. PT sample recoveries are used to document laboratory and method performance.

4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.12 Sample Triplicate (TRP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.13 Grinding Blank (GB): An aliquot of blank sand that is processed through the ring and puck mill between different samples. It is used to monitor for carry over between samples ground with the same bowl set.

4.14 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.15 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Methanol – HPLC grade or equivalent

5.4 Explosives stock standards – Traceable to Certificate of Analysis

5.5 Surrogate standards – 3,4-Dinitrotoluene

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1100 or 1260

Suitable HPLC equipped with an autosampler, pump, and diode array detector.

Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Data System – Agilent Technologies LC Chemstation rev. A 10.01 or B 04.03
Agilent Technologies MS Chemstation rev. DA 00.01 or EA 02.01

6.2.1 A computer system interfaced to the HPLC that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.2.2 The software must allow for quantitation at multiple wavelengths. Additionally, the software should allow for the viewing of the entire UV Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.2.3 Data is archived to a backup server for long term storage.

6.3 Primary Column – Zorbax Extend C-18 3.5u – 4.6mm X 100mm or equivalent

6.4 Confirmation Column– Zorbax Bonus RP (amine bonded C-18) 5u - 4.6mm X 250mm or equivalent

6.5 Gas-tight syringes, syringe filters, and class “A” volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the HPLC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with acetonitrile. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicate analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the explosives are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in 75/25 (v/v) water/acetonitrile. The low standard is at a concentration at or below the LLOQ and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC Conditions

7.2.1 HPLC-BB/PP Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.5	79%	21%
1.5-5.0	72%	28%
5.0-10.0	72%	28%
10.0-15.0	65%	35%
15.0-18.0	50%	50%
18.0-19.0	50%	50%
19.0-19.5	0%	100%
19.5-23.0	0%	100%

Column temperature: 43.0 °C Constant Flow: 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.2.2 HPLC-GG/PP Conditions - Confirmation Column – (Bonus RP)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.00	41%	59%
1.00-1.25	50%	50%
1.25-16.0	47%	53%
16.0-19.0	41%	59%
19.0-22.0	41%	59%

Column temperature: 22.0-23.0 °C Constant Flow: 0.75-0.8 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3. Sample Preparation

7.3.1 Water Samples (extracted)

A 250ml or 1000ml aliquot of sample is extracted utilizing a solid phase cartridge. The cartridge is eluted with acetonitrile. The final volume is then adjusted to 2.0ml or 10ml with reagent water.

7.3.2 Solid Samples

A 10-gram aliquot of sample is extracted with 20ml of acetonitrile utilizing a platform shaker. The final volume is then adjusted to 50ml with reagent water. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.4. HPLC Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the HPLC system must be calibrated, and retention time windows must be determined.

7.4.1.1 External Standard Calibration

A minimum 5-point calibration curve is created for the explosives and surrogates. SGS Orlando routinely performs a 7-point calibration to maximize the calibration range.

The low point may be omitted from the calibration table for any compound with an RL set at the level two standard. Additionally, the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This should be documented in the run log.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

NOTE: Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.

Calibration factors (CF) for the explosives and surrogates are determined at each concentration by dividing the area of each compound by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of CF X 100) / Mean CF

If the %RSD $\leq$ 15%, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as 1/x or $1/x^2$. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq 0.990$) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both % Error and Relative Standard Error (RSE) evaluate the difference between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

% ERR = (xi-x'i) / xi * 100

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be ≤ 30% for all standards. For some data uses, ≤50% may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^{n} \left[\frac{x_i' - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

p = Number of terms in the fitting equation.
(average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

The %RSE acceptance limit criterion is ≤15%.

7.4.1.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 20%. If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis.

For any DoD QSM project, if samples must be analyzed with a target analyte having a %D > 20%, then the data must be qualified accordingly.

If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for TNX, DNX, and MNX.

7.4.1.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.2 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the explosives are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 20% for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc should be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

NOTE: For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the |%D| is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reportable. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: For any DoD QSM project, if samples must be reported with a target analyte having a %D > 20%, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts

Sample Extracts
CCV Standards

7.4.3.2 One hundred microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound.

7.4.3.4 The diode array detector is capable of spectral evaluation; however, the UV spectra for some explosive analytes are not unique. Confirmation by reanalysis on a dissimilar column is required for positive identification. Confirmation analysis should be performed at the same dilution(s) as the primary analysis.

7.4.3.5 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. For LIMS to be able to calculate the difference (%RPD) between primary and confirmation results, the same dilution(s) must be run on each column.

If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as “estimated”; otherwise, the result from the primary column should be reported.

7.4.3.6 If the compound identification does not confirm, then the result should be reported as ND or “U”.

7.4.3.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.4.3.8 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes. Analysis on the confirmation column may also be beneficial.

7.5. Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate “Instrument Repair and Maintenance” log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the “Instrument Repair and Maintenance” log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

DoD QSM projects require the analysis of a sample triplicate (TRP), a proficiency test sample (PT) and equipment grinding blanks (GB).

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD), and sample duplicate (DUP). DoD QSM projects require the analysis of a sample triplicate (TRP), a proficiency test sample (PT) and equipment grinding blanks (GB).

9.1 Surrogates

9.1.1 3,4-Dinitrotoluene is used as the surrogate standard to monitor the efficiency of the extraction.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for the results to be acceptable.

9.1.2 If the surrogate recovery is not within the established control limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, reanalyze the sample. **NOTE: If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary; however, the resulting data must be qualified accordingly.** If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

9.2 Method Blank

9.2.1 The method blank is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification. **NOTE**: **For samples reported to SC DHEC or DoD the associated sample results must still be reported with the B qualifier.**

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

Marginal exceedances are not permitted for analytes that are deemed to be “Compounds of Concern” for a specific project. “Compounds of Concern” are different from “Target Compounds”. “Target Compounds” are all analytes that are being reported for a site where “Compounds of Concern” are those analytes expected to be present at the site

The number of allowable marginal exceedances is as follows:

1) 11-30 analytes in BS, 1 analyte allowed in ME range;

2) < 11 analytes in BS, no analytes allowed in ME range.

NOTE: SC DHEC does not recognize the concept of Marginal Exceedances. Additionally, a secondary check against 70-130% limits should be performed for all analytes reported to SC DHEC.

9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary, and the sample results can be reported without qualification.

9.3.2.4 **If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable; however, the resulting data must be qualified accordingly**.

9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Proficiency Test Sample (DoD QSM ISM soil projects)

9.4.1 The proficiency test sample is a bulk volume soil sample. The PT sample is prepared by an outside vendor at specific analyte concentrations. The PT sample is taken through all preparatory procedures including drying, sieving, grinding, and subsampling.

The surrogate standard is added prior, and the PT sample is then extracted with the other samples to monitor the efficiency of the entire procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (PT Sample Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the Vendors established control limits for the results to be acceptable.

9.4.2 If the PT sample recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary, and the sample results can be reported without qualification.

9.4.2.4 If the recovery of an analyte in the PT sample is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects the resulting data must be qualified accordingly.

9.4.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.6 If the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| \text{MS Result} - \text{MSD Result} | / \text{Average Result}] \times 100$$

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the sample, MS and/or MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary.

9.6 Sample Duplicate

The sample duplicate is a replicate sample aliquot to which the surrogate standard has been added. Sample duplicate is then extracted and taken through all cleanup procedures along with the other samples to monitor the precision of the extraction procedure.

Sample and sample duplicate results for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| \text{Sample Result} - \text{DUP Result} | / \text{Average Result}] \times 100$$

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the sample and/or DUP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary.

9.7 Sample Triplicate (DoD QSM ISM soil projects)

The sample triplicate is an additional replicate sample aliquot to which the surrogate standard has been added. Sample triplicate is then extracted and taken through all cleanup procedures along with the other samples to monitor the precision of the extraction procedure.

Sample, sample duplicate, and sample triplicate results for each analyte are used to calculate the percent relative standard deviation (%RSD) for each compound.

%RSD = [Standard Deviation of the Result / Average Result] X 100

The %RSD for results above the reporting limit must not be greater than 20%. If the %RSD is greater than 20%, the sample, DUP, and/or TRP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the %RSD is still greater than 20%, the department supervisor shall review the data and determine if any further action is necessary.

9.8 Grinding Blanks (DoD QSM ISM soil projects)

9.8.1 The grinding blanks (GB) are aliquots of blank sand that are processed through the ring and puck mill between different samples. They are used to monitor for carry over between samples ground with the same bowl set. The grinding blanks for each bowl set may be composited prior to analysis.

9.8.2 The grinding blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable. If the grinding blanks are not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated grinding blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the individual grinding blanks (non-composited), reanalyzing the samples or qualifying the results with a “B” or “V” qualifier. This must be approved by the department supervisor.

9.8.3 If the grinding blank is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

10.0 CALCULATIONS

The concentration of each explosive in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF]$

$CONC_{inst}$ = Instrument concentration calculated from the initial calibration using mean CF or curve fit
DF = Dilution Factor
V_F = Volume of final extract (ml)
V_I = Volume of sample extracted (ml)
W_I = Weight of sample extracted (g)

Soils are air dried prior to extraction; therefore, %solids are not used in the calculation.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8330A Revision 1, February 2007

SW846 Method 3535A Draft Revision 1, November 2000

SW846 Method 8330B Revision 2, October 2006

DoD Quality System Manual, Version 5.1, January 2017

DoD Quality System Manual, Version 5.3, May 2017

ANALYSIS OF PERCHLORATE BY LC/MS/MS

Prepared by: Norm Farmer Date: 08/15/19

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TITLE: ANALYSIS OF PERCHLORATE BY LC/MS/MS

REFERENCES: SW846 6850

REVISED SECTIONS: 1.1.7 and 12.0

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of Perchlorate in water and solid matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).

1.1.2 The following compound can be reported by this method:

Perchlorate ClO_4^- CAS # 14797-73-0

1.1.3 The Lower Limit of Quantitation (LLOQ) or reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 0.2ug/l for aqueous samples and 2ug/kg for solid samples.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.5 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.6 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.1.7 For DOD projects refer to QSM 5.1 or 5.3 Table B-13 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from SW846 6850.

1.2.2 Samples are received, stored, and extracted within the appropriate holding times.

1.2.3 Water samples are filtered and analyzed directly by HPLC/MS/MS. Soils are extracted with reagent water, filtered and then analyzed by HPLC/MS/MS. Sample preparation is discussed within this SOP.

1.2.4 Perchlorate is separated, detected and quantitated using an HPLC/MS/MS. After HPLC separation and ionization, the perchlorate is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments *m/z* 83 (ClO_3^-), 85 ($^{37}ClO_3^-$), and 89 ($Cl^{18}O_3^-$) are introduced into the second mass spectrometer where they are detected and quantified.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in 125mL polyethylene bottles. A 4oz jar is recommended for solid samples. Containers should only be filled 2/3s of the way. This will reduce potential anaerobic biodegradation.

2.1.2 The samples must be refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be analyzed within 28 days of collection.

2.2.2 Solid and waste samples must be extracted and analyzed within 28 days of collection.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.2 All reagent solutions and samples (including QC samples) should be filtered through 0.45um nominal pore size or smaller (0.2um) membrane syringe filter to remove particulates and prevent damage to the instrument, columns and flow systems. Filters specifically designed for HPLC applications should be used.

3.3 Hydrogen sulfate ion ($H^{34}SO_4^-$), *m/z* 99, formed from a minor sulfur isotope, is commonly present in samples. $H^{34}SO_4^-$ elutes before perchlorate but at high concentrations can tail into the retention time of the perchlorate peak and elevate its baseline at *m/z* 99. Quantitation of perchlorate based on *m/z* 83, 85 and 89 avoids this potential interference from $H^{34}SO_4^-$.

3.4 Retention time shifts may occur as competing anions in the sample take up active sites on the column stationary phase. In such samples, perchlorate will elute earlier than in the calibration standards. The $Cl^{18}O_4^-$ peak from the IRCS will also shift, and therefore is used to confirm the identification of the native perchlorate peak.

3.5 Potential problems may arise when analyzing samples containing high levels of total dissolved solids (TDS) (i.e. salts of chloride, sulfate, carbonate/bicarbonate, etc.). Ionization suppression can occur when high levels of dissolved salts are introduced into the mass spectrometer, resulting in a reduction in the perchlorate analyte peak. The degree of ionization suppression will depend on the type and concentration of interfering ions present, and whether or not they overlap with perchlorate when eluted. The $Cl^{18}O_4^-$ peak from the IRCS will similarly be affected and the internal standard calibration will correct for this effect. However, significant ionization suppression can result in failure to meet the ± 50% IRCS response verification acceptance criterion. Additionally, ionization suppression can result in the complete loss of the analyte signal, particularly when the perchlorate levels of the sample are at or near the LLOQ. Sample dilution, the use of a smaller injection volume or sample cleanup can be used to help minimize this effect.

A conductivity limit study (Section 7.3) should be performed in order to determine the approximate level of TDS that can be tolerated by a particular system before it impacts the chromatographic performance and quantitation.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Conductivity Limit (CL): The threshold of common ionic suppressors that can be present in the system without significantly affecting the quantitation of perchlorate.

4.5 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.

4.6 Interference Check Sample (ICS): A dissolved salt solution prepared at the maximum conductivity limit and fortified with perchlorate at the LLOQ.

4.7 Internal Standards (ISTD): A compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. This may also be referred to as an Internal Recovery and Calibration Standard (IRCS).

4.8 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the LLOQ level.

4.9 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.10 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.11 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.12 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.13 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.14 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Acetic Acid, Glacial – ACS Grade or equivalent.

5.4 Sodium Chloride, NaCl

5.5 Sodium Sulfate, Na_2SO_4

5.6 Sodium Carbonate, Na_2CO_3

5.7 Interference Check Solution (ICS) – 5000mg/l each of chloride, sulfate, and carbonate by dissolving 2.06g NaCl + 2.77g Na_2SO_4 + 2.21g Na_2CO_3 into 250ml of DI.

5.8 Perchlorate stock standards – Traceable to Certificate of Analysis.

5.9 $Cl^{18}O_4^-$ – Internal Standard

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260

Suitable HPLC equipped with an autosampler, pump, and column compartment.

6.2 MS/MS – Agilent Technologies 6460A or 6470

Suitable tandem MS capable of fractionating and monitoring the appropriate ions.

6.3 Data System – Agilent Technologies MassHunter B.07.0x and B.08.0x.

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software should allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Column (RP) – K'(Prime) Technologies 5um 4mm X 250mm or equivalent.

6.5 Vortexer

6.6 Ultrasonic Bath

6.7 Centrifuge – Adequate for clarifying soils extracts prior to filtration.

6.8 15ml Centrifuge tubes

6.9 Disposable Syringes

6.10 Syringe or Vial Filters 0.45um or 0.2um

6.11 Glass screw cap and autosampler vials

6.12 Volumetric Pipettors and class “A” volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike concentrations, preparation information, and vendor part numbers can be found in the LCMS STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with HPLC water. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for Perchlorate are prepared at a minimum of six concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in HPLC water. The low standard is at a concentration at or below the LLOQ and the remaining standards defines the working range of the detector.

Calibration Conc. (ug/l)	Volume (ul) of 100ug/l Perchlorate Intermediate Std	ISTD Conc. (ug/l)	Volume (ul) of 1000ug/l ISTD Intermediate Std	Final Volume (ml)
0.2	20	5	50	10
0.5	50	5	50	10
1	100	5	50	10
2	200	5	50	10
5	500	5	50	10
10	1000	5	50	10
25	2500	5	50	10
50	5000	5	50	10

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

10ul autosampler injection

Mobile phase – Isocratic 50% A and 50% B

Eluent A: 100% Water with 0.1% acetic acid
Eluent B: 100% Acetonitrile with 0.1% acetic acid

Column temperature – 30.0 °C Flow – 1.0 ml/min

7.2.2 MS/MS Conditions

Ionization Mode – ESI w/ Jet Stream

Fragmentation Voltage – 70 to120 V

Collision Energy – 20 to 30 V

Dwell Time 200 msec

Fragmentation Table:

$Cl^{18}O_4^-$ (ISTD) *m/z* 107 to 99
Perchlorate *m/z* 99 to 83
Perchlorate *m/z* 101 to 85

HPLC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Conductivity Limit Study

Before any samples can be run, a conductivity limit study must be performed for each individual HPLC/MS/MS system in order to determine the approximate sample conductivity that can be tolerated before the loss of column capacity brings about a significant reduction in analyte signal. The specific conductivity of each aqueous sample or extract may be measured and recorded and compared to the conductivity limit (CL) in order to determine the approximate amount of sample dilution that may be necessary to produce acceptable perchlorate recovery.

7.3.1 Prepare a 5000mg/l Dissolved Salt Solution (DSS) each of chloride, sulfate, and carbonate by dissolving 2.06g NaCl + 2.77g Na_2SO_4 + 2.21g Na_2CO_3 into 250ml of DI.

7.3.2 Using the above stock, prepare various concentrations of DSS ranging from 500mg/l to 2000mg/l. Fortify each concentration with 0.5 ug/l perchlorate and 5.0 ug/l ISTD.

7.3.3 Analyze the various Dissolved Salt Solutions. The perchlorate recovery should be within 85-115% of the theoretical value and the ISTD recovery within ± 50% of that of the ICV or CCV. If the recovery meets these criteria, then perchlorate may be accurately analyzed in samples having that high a TDS.

7.3.4 Determine the conductivity of the highest acceptable DSS. That will be considered the Conductivity Limit (CL) for the system. For most systems this limit is about 10,000 umhos/cm.

7.3.5 The conductivity of each sample is determined by the General Chemistry Department prior to the analysis of any samples. Samples that exceed the Conductivity Limit may need to be diluted prior to analysis.

7.3.6 For DoD projects, an Interference Check Solution (ICS) must be prepared and analyzed with each batch. The ICS is a DDS prepared at the Conductivity Limit (CL) and fortified with perchlorate at the LLOQ.

7.4 Sample Preparation

7.4.1 Aqueous Samples

7.4.1.1 Remove samples to be analyzed from the storage cooler and allow them to warm to ambient temperature. Transfer 10ml of sample to a 16ml screw top vial.

7.4.1.2 Use 10ml of reagent water for the method blank (MB) and blank spike (BS). Use additional 10ml aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

7.4.1.3 Add 20ul of spike mix to the BS, MS, and MSD.

7.4.1.4 Add 50ul of ISTD solution, cap and invert several times.

7.4.1.5 Store until ready for analysis.

7.4.2 Solid Samples

7.4.2.1 Remove samples to be analyzed from the storage cooler. Transfer 1.0g of sample to a clean 16ml vial or 15ml centrifuge tube. Record the weight to 0.01g on the prep sheet.

7.4.2.2 Add 10ml HPLC grade water to the vial. Cap and shake for about 1 minute.

7.4.2.3 Use 1.0g of blank sand for the method blank (MB) and blank spike (BS). Use additional 1.0g aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

7.4.2.4 Add 20uL of spike mix to the BS, MS, and MSD. Invert each vial several times to mix.

7.4.2.5 Add 50ul of ISTD solution, cap and invert several times.

7.4.2.6 Vortex the mixture, then place the vials in an ultrasonic bath for at least 10 minutes.

7.4.2.7 Remove the vials from the bath and allow the contents to settle.

7.4.2.8 If necessary, centrifuge the samples for 5 minutes to separate the solids from the extract solution.

7.4.2.9 Filter the extract through a .45um or 0.2um Teflon syringe filter to remove any particulate.

7.4.2.10 Transfer 2ml of sample to a labeled 2ml screw top vial.

7.4.2.11 Store until ready for analysis.

7.5 HPLC/MS/MS Analysis

Instrument calibration consists of three major sections:

Mass Tuning and Calibration
Initial Calibration Procedures
Continuing Calibration Verification

7.5.1 Mass Tuning and Calibration

Before samples can be run, the LC/MS/MS system must be mass tuned and calibrated.

The instrument should be hardware tuned per manufacturer's instructions after any maintenance is performed and prior to analyzing a new calibration curve.

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration should be updated as needed. (i.e. QC failures, ion masses showing large deviations from known masses, or major instrument maintenance is performed).

Verify the instrument tune and mass calibration by analyzing a Perchlorate stock standard. The Perchlorate ions should be within ± 0.3 *m/z* of mass 83, 85, and 89.

The theoretical ratio of *m/z* 83/85 should be 3.06 but must fall between 2.3 and 3.8.

7.5.2 Initial Calibration Procedures

Before samples can be run, the HPLC/MS/MS system must be calibrated.

7.5.2.1 Reagent Blank

Analyze a Reagent Blank prior to calibration. The reagent blank must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.

7.5.2.2 Internal Standard Calibration

A minimum 6-point calibration curve is created for Perchlorate.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{analyte} \times C_{istd})/(A_{istd} \times C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{istd} = area of the internal standard
$C_{analyte}$ = concentration of the analyte
C_{istd} = concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of RF} \times 100) / \text{Mean RF}$$

If the %RSD $\leq$ 15%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is $\geq$0.995 (r^2 $\geq$0.990) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Because the low point is verified by the analysis of a low-point CCV standard the use of Percent Error or Percent Relative Standard Error is not used for this method.

7.5.2.3 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for the compound of interest should be $\leq$ 15%. If the ICV does not meet these criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.5.2.4 Retention Time Windows

A retention time window study is not necessary for this method. However, it is beneficial to monitor analyte and ISTD retention times and peak area counts in all samples and QC standards.

Retention time shifts may occur as competing anions (high TDS) in the sample take up active sites on the column stationary phase. In such samples, perchlorate will elute earlier than in the calibration standards. The $Cl^{18}O_4^-$ peak (ISTD) will also shift, and therefore is used to confirm the identification of the native perchlorate peak.

The RRT of the perchlorate ion in a sample is the retention time of the perchlorate ion divided by the retention time of the internal standard. The RRT must be 1.0 ± 2% (0.98 – 1.02).

Retention time windows in the software should be set wide enough so not to miss any potential peaks.

7.5.3 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for perchlorate are prepared at two concentrations; one CCV level should be near the mid-point and the other CCV level should be at the low-point of the calibration curve.

The mid-point CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 15% for the analyte in the mid-point CCV.

Additionally, the low-point CCV must be analyzed at the beginning and end of each run to verify instrument sensitivity. Additional low-point CCVs may be analyzed after every 10 samples in order to reduce the reanalysis rate.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 50% (30% for DoD 4.2 projects) for the analyte in the low-point CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria then the system is considered in control and results may be reported.

If the |%D| is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Qualifying the data should only be done if the sample cannot be reanalyzed. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.5.4 Calibration Blanks

Calibration blanks (Reagent Blanks or Method Blanks) are analyzed to ensure that the system is free of contamination.

The calibration blank must be analyzed at the beginning and end of each run to verify that the system is free of contamination. Additionally, a calibration blank may be analyzed after every CCV.

The calibration blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.

7.5.5 Sample Extract Analysis

7.5.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards
Calibration Blanks
ICS (DoD Projects Only)

7.5.4.2 Internal standard solution was added to sample and QC sample during the sample preparation steps. If the samples or extracts need to be diluted, additional aliquots of ISTD should be added to bring the final concentration to 5.0 ug/l.

7.5.4.3 Ten microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.5.4.4 Tentative identification of an analyte occurs when the peak from the sample extract fall within the retention time window of the target compound.

The RRT of the perchlorate ion in a sample is the retention time of the perchlorate ion divided by the retention time of the internal standard. The RRT must be 1.0 ± 2% (0.98 – 1.02).

Check the ratio of *m/z* 83 to *m/z* 85. The theoretical ratio of *m/z* 83/85 should be 3.06; however, the ratio of *m/z* 83 to *m/z* 85 must be between 2.3 and 3.8.

If the RRT and *m/z* 83/85 both meet the above criteria, then the hit is considered to be confirmed.

7.5.4.5 If the compound identification does not confirm, then the result should be reported as ND or “U”.

7.5.4.6 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.5.4.7 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.6 Maintenance and Trouble Shooting

7.6.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.6.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.6.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.6.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, blank spike duplicate, matrix spike, and matrix spike duplicate samples are compared to **method defined** control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). All control limits are updated annually and are listed in the LIMS.

9.1 Internal Standards

9.1.1 $Cl^{18}O_4^-$ is used as internal standards for this method. The response of the internal standard in all subsequent runs should be ±50% of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard responses should be compared to the internal standard responses for the mid-point standard.

9.1.2 If the internal standard responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference.

9.1.2.5 Verify the conductivity of the sample. If the conductivity is greater than 7500 umhos/cm, then the TDS may be suppressing the response. Reanalyze the sample at increasing dilutions until the acceptance criteria have been met.

9.1.2.6 The sample may need to be reported from the dilution or the results qualified.

9.2 Method Blank and Reagent Blanks

9.2.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest must fall within 80-120% of true value for the results to be acceptable.

9.3.2 If the blank spike recovery is not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects the resulting data must be qualified accordingly.

9.3.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.3.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within 80-120% of true value for the results to be acceptable.

9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for Perchlorate should be less than 15%. If the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

9.5 Interference Check Solution (ICS) (for DoD projects only)

9.5.1 The ICS is a dissolved salt solution that has been prepared at the instruments maximum conductivity limit as determined in Section 7.3. The solution was spiked with perchlorate at the LLOQ and ISTD at 5.0ug/l.

% Recovery = (ICS Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within 80-120% of true value for the results to be acceptable.

9.5.2 If the ICS spike recovery is not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 Prepare and analyze a second ICS at ½ the maximum conductivity limit. If this ICS meets criteria it may be an indication that the column is degraded and either needs to be replaced or that the CL needs to be lowered.

9.5.2.4 If the CL is to be lowered, confirm that the conductivity of each sample was lower than the new CL. If the conductivity of any sample was higher than the new CL, dilute and reanalyze the sample.

9.5.2.5 Under no circumstances should samples or extracts with a conductivity greater than the CL be reported without being properly diluted.

10.0 CALCULATIONS

The concentration of Perchlorate in the original sample is calculated as follows:

Water (ug/l) = $(\text{CONC}_{\text{inst}}) \times (V_F / V_I) \times \text{DF}$

Soil (ug/kg) = $[(\text{CONC}_{\text{inst}}) \times (V_F / W_I) \times \text{DF}] / \%\text{solids}$

$\text{CONC}_{\text{inst}}$ = Instrument concentration calculated from the initial Calibration using mean CF or curve fit.
DF = Dilution Factor
V_F = Volume of final extract (ml)

V_I = Volume of sample extracted (ml)
W_I = Weight of sample extracted (g)
%solids = Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 6850 Revision 0, January 2007

DoD Quality Systems Manual Version 5.1, January 2017

DoD Quality Systems Manual Version 5.3, May 2019

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES FROM SOLID SAMPLES FOR HPLC ANALYSIS BY SW-846 8330B.
ISM SAMPLES via RING AND PUCK MILL
DISCREET SAMPLES via MORTAR AND PESTLE

Prepared by: Norm Farmer Date: 04/22/20

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Annual Review

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TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES FROM SOLID SAMPLES FOR HPLC ANALYSIS BY SW-846 8330B.
ISM SAMPLES via RING AND PUCK MILL
DISCREET SAMPLES via MORTAR AND PESTLE

REFERENCES: SW846 8330B

REVISED SECTIONS: 1.2, 3.1.2, 5.6, 5.7, 6.6, 7.25-7.26, 7.32, 9.3 and 9.4 Added 8.1-8.25 for Discreet samples Deleted 5.8

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

Solid samples are air dried, sieved, and ground to a fine powder. Samples are then extracted with acetonitrile for 18 hours using a platform shaker table. The extracts are filtered and stored in amber glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for Explosives analysis by HPLC method SW-846 8330B. Separate procedures are listed in this SOP for ISM samples (Section 7) and Discreet samples (Section 8). For additional Department of Defense requirements for ISM samples see Appendix A. This SOP is not applicable to samples submitted for analysis by SW-846 8330A.

2.0 DISCUSSION AND COMMENTS

This procedure is adapted from SW-846 method 8330B. The method outlined in this SOP is designed for low and high concentration samples. Samples expected to contain high levels of explosives or samples that contain orange or reddish-brown clay like material should be screened prior to grinding. This can be done by micro-extracting 0.5-1.0 grams of sample (or suspect material) with 10ml of acetonitrile and analyzing it on the HPLC. If the samples contain more than 2% explosives, they should not be ground.

Department of Defense contractors should screen all samples in the field for large pieces of explosive materials. Any large pieces of explosive material should be removed prior to sending the samples to the lab. However, the prep analysis should use caution when handling any samples for 8330B. If there are chunks of colored clay like material, large metal fragments, or any other suspicious material, contact the department supervisor immediately. Never grind any of this material without a thorough review.

The HPLC detector is extremely sensitive and will respond to many organic compounds. It is important to minimize extraneous contaminants and carryover by scrupulously cleaning all glassware, trays, and grinding equipment and by using only high purity reagents. Additionally, all extraction items that contact the sample should be made from glass, steel, wood, or Teflon.

3.0 PRESERVATION AND HOLDING TIMES

3.1 Preservation

3.1.1 This method utilizes multi-incremental sampling to collect large volume samples. This can result in sample sizes of one to two kilograms. Samples shall be collected in heavy duty 1 or 2-gallon zip-lock bags. It is recommended that the samples be double bagged to prevent punctures.

3.1.2 Smaller volume discreet samples may be collected in 250ml amber glass jars with Teflon lined caps.

3.1.3 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until drying. Once the samples have been air dried, they can be stored at room temperature. Samples should still be protected from light. The extracts must be refrigerated at ≤ 6°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet. **NOTE:** Extremely wet samples may take longer than the 14-day hold time to air dry. This must be communicated to the client.

3.2.2 Extracts should be analyzed as soon as possible but must be analyzed within 40 days of extraction.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples that are extracted at the same time.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. Blank Spike recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still are considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Proficiency Test Sample (PT): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The PT sample is generally prepared by an outside vendor. This method requires that the PT sample go through the entire preparatory procedure including sieving and grinding. PT sample recoveries are used to document laboratory and method performance.

4.8 Sample Duplicate (DUP): A replicate sample taken after grinding which is used to document the precision of a method in a given sample matrix.

4.9 Sample Triplicate (TRP): A replicate sample taken after grinding which is used to document the precision of a method in a given sample matrix. DoD projects require the analysis of the sample triplicate.

4.10 Grinding Blank (GB): An aliquot of blank sand that is processed through the ring and puck mill between different samples. It is used to monitor for carry over between samples ground with the same bowl set.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Acetonitrile – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Water – HPLC grade or equivalent

5.4 Blank Sand – precleaned to remove contaminants

5.5 Soil PT Sample – Environmental Resource Associates or Equivalent to meet DoD QSM requirements.

5.6 Explosives Surrogate Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.7 Explosives Spike Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 GLASSWARE AND APPARATUS

6.1 Aluminum baking trays – Half pan 18” x 13” or Full pan 18” x 26”

6.2 Aluminum foil and weigh dishes

6.3 Drying Cabinet

6.4 #10, #60, and #200 Brass or Stainless-Steel Sieves

6.5 Spatula – stainless steel, wooden, or Teflon

6.6 Mortar and Pestle – Glass or ceramic (Discreet Samples only)

6.7 Ring and Puck Mill

6.8 800cc bowls and pucks for Mill

6.9 0.5ml, 1.0ml, and 2.5ml syringes

6.10 4-ounce glass jars with Teflon lined caps

6.11 10.0-50.0ml repeat pipettor

6.12 Platform Shaker Table

6.13 Disposable 3.0ml or 5.0ml syringes

6.14 0.20um or 0.45um Teflon syringe filters

6.15 2.0ml amber glass screw cap vials – caps must have Teflon lined septa

6.16 Heavy Duty 1 and 2-gallon Zip-lock bags

6.17 Nitrile Gloves – shown to be interference free

6.18 Hi-Lo Thermometer

6.19 Downdraft Tables with Vacuum Filtration System

6.20 Top loading balance – capable of weighing samples to +/- 0.01 grams

6.21 Top loading balance – capable of weighing 2-kilogram samples to +/- 0.1 grams

7.0 PROCEDURE (ISM)

7.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the HPLC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 This method requires that the entire soil sample be processed prior to the final extraction procedure. Sample volumes received should typically be around 1 kilogram. The minimum sample volume that may be ground is 200 grams. If small sample volumes are received, or if there are additional analysis requested, notify the department supervisor. Department supervisor will need to confirm with Technical Director and/or Project Managers.

7.3 Label the side of an aluminum baking tray with the sample ID. Transfer the entire sample to tray, taking care to remove as much sample residue from the container as possible. Use a clean spatula and new pair of gloves for each sample. Spread the sample out to facilitate drying. Breakup any large clumps as much as possible. If the samples appear to contain a lot of clay, score the sample to facilitate breaking it into smaller pieces later.

7.4 Repeat this procedure for all of the samples in the batch. Prepare one tray with approximately 500 grams of clean sand. The amount of sand used for the method blank and blank spike should be similar to the mass of a typical sample that is ground in one aliquot. This will be dried, sieved and ground for use as the method blank (MB) and blank spike (BSP).

7.5 Samples must not be heated and should not be exposed to direct sunlight. Place the samples in the drying cabinet. Turn on the fans in the cabinet. Flow should be set high enough to keep air circulating, but not so high that sample would be drawn across the trays. Allow the samples to dry at room temperature, generally 2 to 5 days.

7.6 Record the room temperature in the appropriate logbook during each day of drying. If room temperature exceeds 26°C, notify the department supervisor. Department supervisor will need to notify the Technical Director and/or Project Managers who will notify the client.

7.7 A sample is generally considered dry when it is free flowing and any large clumps crumble easily. To test for dryness, transfer approximately 10 grams of sample to a labeled aluminum weigh dish. Weigh the sample and dish. Record this in the 8330B Air Drying Log. Return the sample and weigh dish to the drying cabinet. After a minimum of two hours, reweigh the sample and dish. If the weight did not change by more than 0.1 grams, the sample is considered dry.

7.7.1 If the weight changed by more than 0.1 grams, return the sample and weigh dish to the drying cabinet and check again after a minimum of two hours. If the weight did not change by more than 0.1 grams, the sample is considered dry.

7.7.2 If the weight is not constant after the 3rd weighing, the sample needs to dry longer. Repeat the process after and an additional 24 to 48 hours.

7.8 **NOTE**: The sieving and grinding procedures can generate a lot of dust. Utilize the downdraft tables when working with the samples to minimize dust transfer. Samples should be covered with aluminum foil or stored in the drying cabinet when not being processed. This reduces chances of cross contamination from other samples and degradation from light.

7.9 Once the samples are dry, transfer each one to an appropriately labeled mixing bowl. Record the weight of the entire sample to the nearest gram in the 8330B Weight Log.

7.10 The samples are sieved through a #10 stainless steel sieve. Breakup any clumps of soil with gloved hands (use a new pair of gloves for each sample). Do not intentionally include vegetation unless it is part of the project requirement. Excess vegetation should be stored with the portion that is unable to pass through the sieve.

NOTE: Samples with high clay content tend to form “bricks” when dried. It may not be possible to sieve this type of sample. Use the scored lines to break the sample into small pieces. The smaller pieces will be processed as if they had passed through the sieve. Note this in the prep log.

7.11 Collect and weigh any portion unable to pass through the sieve. Record the weight to the nearest gram. Record a brief description of the material. Store this fraction in a labeled zip-lock bag.

7.12 If samples are to be analyzed for metals prior to grinding, please see **Appendix A2.0** for the sub-sampling procedure.

CAUTION: DO NOT OPERATE RING AND PUCK MILL WITHOUT PROPER TRAINING.

7.13 Once the samples have been sieved, they must be ground to a fine powder. The 800cc can accommodate up to 600 gram sample aliquots. Do not overload the bowls, as this will decrease the grinding efficiency. Large sample volumes may require that multiple aliquots be ground. Use one bowl, puck and lid set for each sample. Do not use multiple sets per sample. Record the grinding order in the Grinding Log.

Specific Project Plans may require that the grinding step be skipped. This would be appropriate for production facilities or other sites were the contaminants were dispersed in a liquid form instead of a particulate form. For these samples, proceed to section 7.19.

7.14 **NOTE:** Do not grind aliquots less than 100 gram because this will cause excessive wear on the bowl and puck.

CAUTION: SAMPLES EXPECTED TO CONTAIN HIGH LEVELS OF EXPLOSIVES SHOULD BE SCREENED USING METHOD 8510, 8515 OR OTHER APPLICABLE METHODS. IF THE SAMPLES CONTAIN MORE THAN 2% EXPLOSIVES, THEY SHOULD NOT BE GROUND.

7.15 Process one sample at a time. Place the appropriate puck in the appropriate bowl. Transfer 500 to 600 grams of a sample to the bowl. Place the appropriate lid on the bowl. Use the pneumatic lift to load the bowl into the mill. Record the grinding order in the Grinding Log.

7.16 Close the lid to the mill. The mill will not operate with the lid open. Press and hold the green start button. Once the mill starts, release the button. The mill is programmed to run for 1 minute. Samples suspected of containing crystalline energetic residues (TNT, RDX, HMX, and their breakdowns) can be adequately ground using 2 one-minute cycles. Samples suspected of containing polymeric residues (propellants and nitrocellulose) can be adequately ground using 5 one-minute cycles. Accutest grinds all samples for a minimum of 5 one-minute cycles to ensure adequate grinding regardless of residue type. Allow the sample and bowl to cool between each grind. See **Appendix A3.0** for grinding temperature study.

7.17 Repeat the grinding procedure for each sample aliquot until the entire sample has been processed. The bowl, puck and lid must be thoroughly cleaned between different samples; however, it is not necessary to clean the bowl, puck and lid between multiple aliquots of the same sample.

The bowls, pucks, and lids are cleaned with water and detergent solution. Brushes are used to facilitate the process. Particular attention must be paid to the grinding edges and handle of the puck. The bowls, pucks, and lids are then rinsed with tap water and DI water. The bowls, pucks, and lids cannot be allowed to air dry. The low chrome content of material will cause surface rusting. The bowls, pucks, and lids should be rinsed with methanol and then dried with disposable towels.

See **Appendix A4.0** for additional DoD requirements for the preparation of grinding blanks.

7.18 Document the sample ID, bowl set, and grinding order in the appropriate logbook.

7.19 Transfer all of the aliquots of a sample to a large zip-lock bag. Sample should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

7.20 Place a baking tray on the downdraft table. Spread out the sample on a baking tray so that it is approximately 1 cm thick.

7.21 Using a spatula, collect at least 30 different increments (~0.3 gram each) from randomly chosen locations in the sample. Combine the increments in an appropriately labeled 4-ounce jar. Nominal sample size should be 10 grams. Record the weight to the nearest 0.01 gram on the prep sheet.

7.22 Close the jar and repeat this procedure for each sample including the QC samples. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) and duplicate (DUP). Use 10.0 gram aliquots of clean sand for the MB and BS. Use additional 10.0 gram aliquots of a sample for the MS, MSD, DUP, and TRP. Record the sample ID, bottle number, and weight on the prep sheet.

7.23 DoD projects require the analysis of a proficiency test sample (PT) per batch. **NOTE:** If the samples do not require grinding, then the PT sample does not need to be extracted or analyzed. See **Appendix A5.0**.

The PT sample differs from the blank spike in two ways. An outside vendor generally prepares the PT sample. The PT sample must be processed through all preparatory steps, including grinding. However, the PT sample should not be air dried; this would result in the loss of the more volatile components.

The PT sample should be ground in the same manner as the samples. The ground PT should be stored in a sealed glass jar. Generally, the PT sample is ground when it is first opened and then sub-sampled for multiple batches. It is cost prohibitive to grind a fresh PT sample with each batch of samples; however, some project plans may require that a fresh PT sample be prepared for the project.

7.24 Using the dedicated surrogate syringe add 1.25ml of 8330 surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

7.25 Using the dedicated spike syringe add 1.25ml of 8330 spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

7.26 Using a graduated pipettor or cylinder, add **18.75ml** of acetonitrile to each of the sample vials, the method blank (MB), sample duplicate (DUP), and sample triplicate (TRP). Add **17.5ml** of acetonitrile to the BS, MS, and MSD. This will result in **20.0ml** of acetonitrile in each of the jars.

7.27 Put the cap on each jar and shake briefly to mix.

7.28 Place the jars in the covered rack on the platform shaker.

7.29 Shake the samples at a rate of 100 rpm for 18 hours. After 18 hours, turn off the shaker and remove the jars.

7.30 Using a repeat pipettor or graduated cylinder add 30.0ml of water to each of the samples including the QC samples.

7.31 Put the cap on each jar and shake briefly to mix. This results in a final volume of 50.0 ml.

7.32 Transfer 3-5ml of extract to disposable syringe. Attach a Teflon syringe filter to the disposable syringe. Discard the first 1ml of filtrate.

7.33 Filter the extract into appropriately labeled amber 2.0ml screw cap vial.

CAUTION: WEAR SAFETY GLASSES, THE EXTRACT MAY SPRAY IF THE FILTER CLOGS.

7.34 Store the extracts in the “extract refrigerator” until they are needed for analysis.

8.0 PROCEDURE (Discreet)

8.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the HPLC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

8.2 This method requires that the entire soil sample (entire jar) be processed prior to the final extraction procedure. If small sample volumes are received, or if there are additional analysis requested, notify the department supervisor. Department supervisor will need to confirm with Technical Director and/or Project Managers.

8.3 Transfer each sample to the appropriately labeled weighing dish or tray. Use a clean spatula for each sample. Record the sample ID and bottle number on the prep sheet.

8.4 Repeat this procedure for all the samples in the batch. Prepare one tray with approximately 100 grams of clean sand. The amount of sand should be similar to the mass of a typical sample. This will be dried, sieved, and ground for use as the method blank (MB) and blank spike (BSP).

8.5 Samples must not be heated and should not be exposed to direct sunlight. Place the samples in the drying cabinet. Turn on the fans in the cabinet. Flow should be set high enough to keep air circulating, but not so high that sample would be drawn across the trays. Allow the samples to dry at room temperature, generally 1 to 3 days.

8.6 Record the room temperature in the appropriate logbook during each day of drying. If room temperature exceeds 26°C, notify the department supervisor. Department supervisor will need to notify the Technical Director and/or Project Managers who will notify the client.

8.7 A sample is generally considered dry when it is free flowing and any large clumps crumble easily.

8.8 Once the samples are dry, transfer each one to an appropriately labeled mixing bowl. Record the weight of the entire sample to the nearest gram in the 8330B Weight Log.

8.9 The samples are sieved through a #10 stainless steel sieve. Breakup any clumps of soil with gloved hands (use a new pair of gloves for each sample). Do not intentionally include vegetation unless it is part of the project requirement. Excess vegetation should be stored with the portion that is unable to pass through the sieve.

8.10 Collect and weigh any portion unable to pass through the sieve. Record the weight to the nearest gram. Record a brief description of the material. Store this fraction in a labeled zip-lock bag.

8.11 Transfer each sample to a ceramic or glass mortar. Use the appropriate pestle to grind each sample. Soil samples that are known to contain high concentrations or explosives should not be ground. They may DETONATE.

8.12 Place a baking tray on the downdraft table. Spread out the sample on a baking tray so that it is approximately 1 cm thick.

8.13 Using a spatula, collect at least 30 different increments (~0.3 gram each) from randomly chosen locations in the sample. Combine the increments in an appropriately labeled 4-ounce jar. Nominal sample size should be 10 grams. Record the weight to the nearest 0.01 gram on the prep sheet.

8.14 Close the jar and repeat this procedure for each sample including the QC samples. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) and duplicate (DUP). Use 10.0 gram aliquots of clean sand for the MB and BS. Use additional 10.0 gram aliquots of a sample for the MS and MSD. Record the sample ID, bottle number, and weight on the prep sheet.

8.15 Using the dedicated surrogate syringe add 1.25ml of 8330 surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

8.16 Using the dedicated spike syringe add 1.25ml of 8330 spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

8.17 Using a graduated pipettor or cylinder, add **18.75ml** of acetonitrile to each of the sample vials, the method blank (MB). Add **17.5ml** of acetonitrile to the BS, MS, and MSD. This will result in **20.0ml** of acetonitrile in each of the jars.

8.18 Put the cap on each jar and shake briefly to mix.

8.19 Place the jars in the covered rack on the platform shaker.

8.20 Shake the samples at a rate of 100 rpm for 18 hours. After 18 hours, turn off the shaker and remove the jars.

8.21 Using a repeat pipettor or graduated cylinder add 30.0ml of water to each of the samples including the QC samples.

8.22 Put the cap on each jar and shake briefly to mix. This results in a final volume of 50.0 ml.

8.23 Transfer 3-5ml of extract to disposable syringe. Attach a Teflon syringe filter to the disposable syringe. Discard the first 1ml of filtrate.

8.24 Filter the extract into appropriately labeled amber 2.0ml screw cap vial.

CAUTION: WEAR SAFETY GLASSES, THE EXTRACT MAY SPRAY IF THE FILTER CLOGS.

8.25 Store the extracts in the “extract refrigerator” until they are needed for analysis.

9.0 QUALITY ASSURANCE AND QUALITY CONTROL

9.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. Samples cannot be added to the batch after the grinding procedure has started.

9.2 A method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD), duplicate (DUP), triplicate (TRP), and ground PT sample must be extracted with each new batch of ISM samples.

9.3 A method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD), must be extracted with each new batch of discreet samples

9.4 Additional QA/QC requirements for ISM samples are listed in Appendix A.

10.0 SAFETY AND WASTE DISPOSAL

10.1 Safety

10.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

10.1.2 Avoid grinding samples that may contain high levels of explosives. The grinding action may cause them to DETONATE.

10.1.3 **Hearing protection** should be worn while operating the ring and puck mill.

10.1.4 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

10.1.5 Acetonitrile is an inhalation hazard and suspected carcinogen. Use in well ventilated area.

10.1.6 The fine dust created during the drying, sieving, and grinding procedures is an inhalation hazard. Fume hoods or downdraft tables should be used to minimize exposure to dust.

10.2 Waste Disposal

10.2.1 Waste acetonitrile is placed in the “non-chlorinated waste” container.

10.2.2 Extracted soil samples and residual acetonitrile may be poured into the “non-chlorinated waste” container or the entire jar may be lab packed with the “extract waste”.

10.2.3 The remaining processed soil samples and material that did not pass through the #10 sieve should be bagged, labeled, and stored until time of disposal. **NOTE:** Soils from foreign soils must follow additional “foreign soil” disposal requirements.

10.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

11.0 REFERENCES

SW-846 Method 8330A, Rev. 1, 02/07

SW-846 Method 8330B, Rev. 2, 10/06

DoD Quality Systems Manual Version 5.3, 2019

Extraction Kinetics of Energetic Compounds from Training Range and Army Ammunition Plant Soils: Platform Shaker versus Sonic Bath Methods, M.E. Walsh and D.J. Lambert, ERDC/CRREL TR06-6, 2006

DoD Environmental Data Quality Workgroup, Guide for Implementing EPA SW-846 Method 8330B, July 2008

DoD Environmental Data Quality Workgroup, DoD Training – ELAP Requirements for 8330B, December 2014

Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities, ASTM D 6323, 1998 (Re-approved 2003)

ESSA Mill Instruction Manual

APPENDIX A

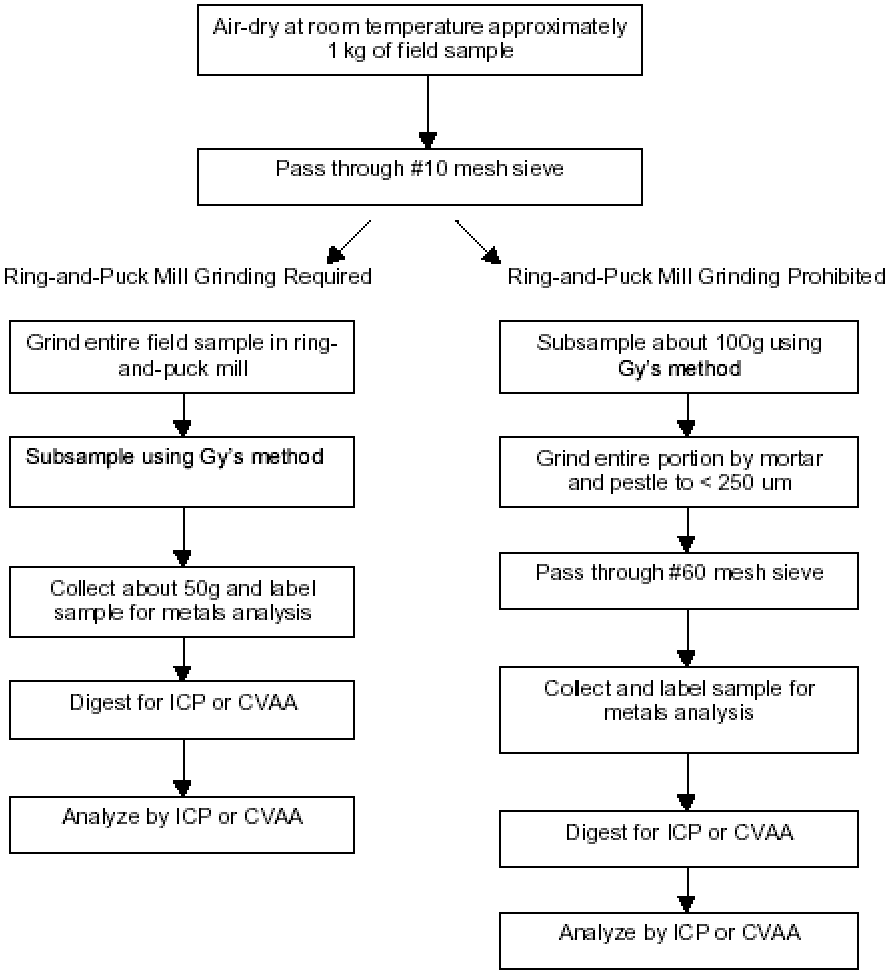
A1.0 Application

Appendix A is designed to supplement SOP OP046.x for the preparation of soil samples for SW-846 8330B. This appendix outlines additional requirements for compliance with Department of Defense QSM 4.2 and 5.0 projects.

A2.0 Sub-sampling for Metals

Some projects require that metals analysis be performed on the multi-incremental sample that was collected for 8330B. The technique used should be listed in the project QAPP or SOW. Consult the client if this information is not available.

See flow chart below for various subsampling techniques:



If Ring and Puck Mill grinding is required, then proceed with the grinding procedure listed in this SOP for explosives. The metallic components from the Ring and Puck Mill may introduce chromium and iron into the sample.

After grinding, place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick.

> Use a spatula to collect 30-50 different increments (~1.0 gram each) from randomly chosen locations in the sample. Combine the increments in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.
>
> Alternatively
>
> Use a rectangular scoop to collect multiple top-to-bottom cuts across the sample (see figure 1 below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.
>
> Transfer the samples to the metals department for analysis.

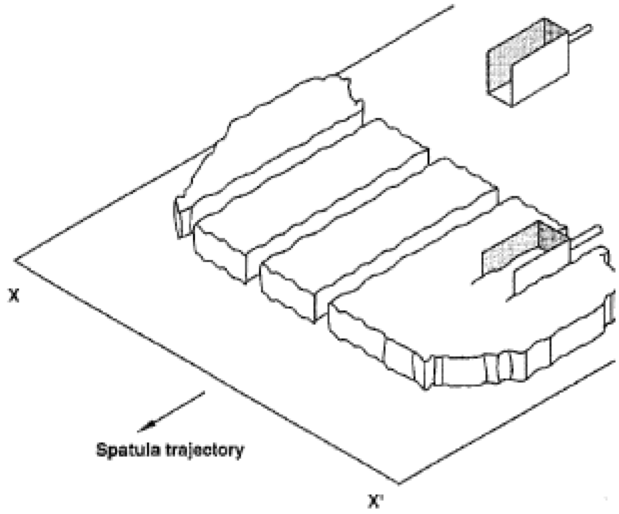


FIG. 1 Transversal Subsampling

If grinding is to be done by mortar and pestle, then follow the procedure listed below.

Transfer the air dried and sieved sample to a large zip-lock bag. Seal the bag and thoroughly mix the sample.

Place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick.

Use a spatula to collect 30-50 different increments (~1.0 gram each) from randomly chosen locations in the sample. Combine the increments in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Alternatively

Use a rectangular scoop to collect multiple top-to-bottom cuts across the sample (see figure 1 below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Return the remaining sample to the zip-lock bag or mixing bowl.

Grind each sample and MB to a particle size less than 250 um with a non-metallic mortar and pestle. Collect and label the samples.

Transfer the samples to the metals department for analysis.

If additional sieving is required, then follow the procedure listed below.

In section 7.10, place a #60 sieve after the #10 sieve. Specific projects may require alternate sieve sizes. Sieve the sample through the #10 and #60 sieves.

Collect and weigh any portion unable to pass through each sieve. Record the weight to the nearest gram. Record a brief description of the material. Store this fraction in a labeled zip-lock bag. The aliquot that passed through the #60 is generally what will be analyzed.

Transfer the air dried and sieved sample to a large zip-lock bag. Seal the bag and thoroughly mix the sample.

Place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick.

Use a spatula to collect 30-50 different increments (~1.0 gram each) from randomly chosen locations in the sample. Combine the increments in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Alternatively

Use a rectangular scoop to collect multiple top-to-bottom cuts across the sample (see figure 1 below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Return the remaining sample to the zip-lock bag or mixing bowl.

Collect and label the samples. Transfer the samples to the metals department for analysis.

A3.0 Sample Grinding Cycles

Samples for DoD projects require that all samples be ground for **5** one-minute cycles. Samples should be allowed to cool for at least two minutes between cycles. DoD guidelines originally require that the puck be removed from the sample between grinding cycles; however, this is not necessary since the heat generated is far less than expected. Results of an in-house temperature study are shown in Table 1:

TABLE 1

4/24/2008	Sample at Puck Grinding Area	Lid	Outer Bowl at Contact Area
Starting Temperature	22.4	22.8	22.8
After 1st minute	24.6	23.6	23.8
After 2nd minute	24.8	23.4	25.2
After 3rd minute	25.4	23.6	25.2
After 4th minute	25.8	24.2	25.2
After 5th minute	26.0	24.6	25.2
Temperatures in Degree C by IR thermometer.			
At the end of each minute, the grinding bowl was removed from the ring and puck mill to measure the temperature of the lid and outer bowl, and then opened briefly to measure the temperature of the sample at the puck. Total time between grinds was approximately 15 seconds.			

A4.0 Cleaning Process and Grinding Blanks

The aluminum baking trays, mixing bowls, stainless steel sieves and grinding equipment must be completely cleaned between samples. The trays, bowls, and sieves are cleaned with water and detergent solution. Brushes are used to facilitate the process. The trays, bowls, and sieves are then rinsed with tap water and DI water. These items are allowed to air dry or they can be rinsed with methanol to speed up the drying process.

The bowls, pucks, and lids are cleaned in a similar fashion. Particular attention must be paid to the grinding edges and handle of the puck. It is not necessary to clean the bowl, puck and lid between multiple aliquots of the same sample. The bowls, pucks, and lids cannot be allowed to air dry. The low chrome content of material will cause surface rusting. The bowls, pucks, and lids should be rinsed with methanol and then dried with disposable towels.

Bowls, pucks, and lids are numbered as sets. In order to properly track and assess potential cross-contamination, the bowl sets must not be mixed. The grinding order must be documented, and a grinding blank must be prepared on each bowl set prior to use and between each sample. It is not necessary to prepare a grinding blank between multiple aliquots of the same sample. See Grinding Log for numbering instructions.

Grinding blanks for each Ring and Puck set should be prepared before the first sample and after the last sample (not to exceed 10 samples).

To prepare a grinding blank, place the appropriate puck in the appropriate bowl. Transfer a volume of blank sand similar to that used for the samples (200-500 grams) to the bowl. Place the appropriate lid on the bowl. Use the pneumatic lift to load the bowl into the mill. Record the grinding order in the Grinding Log.

Close the lid to the mill. The mill will not operate with the lid open. Press and hold the green start button. Once the mill starts, release the button. The mill is programmed to run for 1 minute. The grinding blank can be adequately ground using 2 one-minute cycles.

Transfer the grinding blank to an appropriately labeled zip-lock bag. This should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

The grinding blanks for each Ring and Puck Set can be sub-sampled and composited into a single sample to prior to extraction. This would result in a maximum of 3 grinding blanks if all 3 Ring a Puck sets were used.

A5.0 Proficiency Test Sample Requirements

Samples for DoD projects require an additional proficiency test (PT) sample. The PT sample differs from the blank spike in two ways. An outside vendor generally prepares the PT sample. The PT sample must be processed through all preparatory steps, including grinding. However, the PT sample should not be air dried; this will result in the loss of the more volatile components.

The PT sample is generally supplied as a 500gram sample. The PT may be split into 2 x 250gram aliquots. If the PT is split, store the second aliquot in a sealed glass jar at ≤ 6°C until needed.

The PT sample should be ground in the same manner as the samples. The ground PT should be stored in a sealed glass jar at ≤ 6°C. Generally, the PT sample is ground when it is first opened and then sub-sampled for multiple batches. It is cost prohibitive to grind a fresh PT sample with each batch of samples; however, some project plans may require that a fresh PT sample be prepared for the project.

NOTE: The PT sample may not contain all analytes of interest for a given project. If additional analytes are required, they must be spiked into the PT sample prior to grinding.

A6.0 Grinding Demonstration

The adequacy of the grinding by the ring and puck mill can be checked by periodically placing a small aliquot of a grinding blank on a #200 sieve and checking to see if the material passes through the sieve. Since this is a 75um sieve, it would take a long time to process a large aliquot.

A7.0 Ring and Puck Mill Maintenance

Refer to equipment manual for details on scheduled maintenance items. **NOTE**: If the Ring and Puck mill is not being used weekly then the Daily, Weekly, and Monthly Maintenance can be extended.

Daily Maintenance

Press drain buttons to expel any water in pneumatic lines.

Check air pressure supply is a minimum of 80 psi.

Weekly Maintenance

Check floor mounting bolts for signs of corrosion or fatigue.

Inspect bowl lid o-rings for signs of wear. Replace o-rings as needed.

Monthly Maintenance

Inspect platform insert for signs of wear on load bearing surfaces. Replace insert when wear exceeds 2mm.

Empty dust tray.

Other Maintenance

Lubricate motor plate bearings and drive shaft every 150 hours of use.

Check belt tension every 150 hours of use.

SAMPLE RECEIPT AND STORAGE

Prepared by: Heather Wandrey Date: 10/10/2019

Approved by: Svetlana Izosimova Date: 10/10/2019

Annual Review

Reviewed by: ____________________ Date: __________

Reviewed by: ____________________ Date: __________

Reviewed by: ____________________ Date: __________

Document Control

Issued to: QA Department Date: 10/10/2019

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Issued to: ____________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: SAMPLE RECEIPT AND STORAGE

REFERENCES: TNI Standards 2009 and 2016, State of Florida DEP SOPs, 40 CFR Part 136, DoD QSM 5-series.

REVISED SECTIONS: Revised residual chlorine check procedure in 2.4.1 – 2.4.3; removed unnecessary steps in 2.6; revised 2.9; update references to QSM 5-series, updated SOP name to conform with Corporate naming convention.

1.0 SCOPE AND APPLICATION

To maintain documentation of custody of all bottle sets, samples (domestic and foreign), digestates, distillates, and extracts that fall under the responsibility of SGS North America, Inc. - Orlando.

2.0 EXTERNAL CHAIN-OF-CUSTODY PROCEDURE

2.1 Samples are received via commercial carrier, client delivery, or are picked up by SGS - Orlando employees. Upon receipt, sample management inspects the outside of the container for signs of tampering, such as a torn or missing custody seal. The staff reviews Chain Of Custody (CoC) document for the following information:

2.1.1 Client Information- Name / Address, Phone and Fax contact numbers

2.1.2 Facility Information- Project name, Location, Project Number.

2.1.3 Field ID / Point of Collection- Date- Time- (HOLD TIMES) Samplers Initials- # of containers Shipped, Preservative types.

2.1.4 Matrix of samples: WW- water, GW-ground water, SW-surface water, DW-drinking water, SO-Soil, SOL-other solid, LIQ-other liquid, OI- Oil, AIR-air, WP- Wipe, FB-field blank, TB-trip blank.

2.1.5 Analytical Information- Samples with hold times of 72 hrs or less remaining on analyses upon receipt are considered Short Hold Samples and are listed on Short Hold Notification form in order of hold times, from ASAP to 7 days with less than 3 days left. These samples are processed immediately. Job Numbers are assigned, and the samples are given directly to the appropriate lab. Copy of CoC and completed Short Hold Notification Form are relinquished to the appropriate lab by the sample receiving technician. Laboratory personnel accept the samples, time of transfer is recorded, both parties sign SHNF and a copy of the SHNF is attached to CoC. (See Attachment I, Short Hold Notification Form)

2.1.5.1 VOC soil sample vials must be frozen within 48 hours of collection. Receiving technicians review sample times and deliver samples with a SHNF if sufficient hold-time remains to process the samples. If samples are close to expiring the samples are immediately placed in the freezer with a card notating the time they were placed in the freezer.

2.1.6 TURN AROUND TIME- Samples with a 6 day or less TAT are processed as soon as possible, depending on samples with short hold status.

2.1.7 Sample custody documentation signatures – relinquished/received in Client – Carrier – Laboratory sequence. Per FL DEP SOPs signature shall consist of full signature – no initials allowed – and business affiliation.

2.1.8 Special Requirements and or comments - Compositing, filtering or preservation of samples, Extended sample storage etc.

2.2 Samples are processed by a two-technician team, The sample custodian(s) accepts sample custody upon receipt of samples and verifies that the custody document is correct. Sample conditions, sample temperature, and other observations, including custody seal condition, are documented in detail on the electronic Sample Receipt Confirmation form (p-note).

2.2.1 Temperature is measured using IR thermometer against white label on temperature blank, or on the sample container, if temperature blank is absent. **NOTE: For jobs originated in West Virginia every sample container must be checked.** This thermometer is calibrated measuring the temperature off of white sample label against NIST-traceable liquid-in-glass thermometer – see SOP QA002, current revision. When recording the cooler temperature with the use of an IR gun the following needs to be documented on Sample Receipt Confirmation Form:

2.2.1.1 IR gun used.
2.2.1.2 Correction factor.
2.2.1.3 Observed cooler temperature.
2.2.1.4 Corrected cooler temperature.

2.2.2 Verify IR thermometer correction factor gains Correction factor recorded in Receipt utility to make sure it is correct in both locations. Notify QA/Department Manager if these values are not the same. Apply temperature correction factor for a face value – positive number to be added to direct reading temperature, negative correction factor to be subtracted.

2.2.3 **Samples must remain in coolers full of ice until it is time to process the job for login. Coolers received out of temperature range have initial temperature recorded and are then placed into a Walk-In cooler until resolution from client is received.** 40 CFR part 136, TNI Standards 2009, 2016 revision and DoD QSM 5.1 all designate acceptable temperature as “above freezing and below 6°C”. Temperature is measured and recorded to first decimal place due to state-specific and client-specific requirements.

2.2.4 Any discrepancies or non-compliant situations are documented on the Sample Receipt Confirmation Form (p-note) which is automatically e-mailed to the SGS -

Orlando Project Manager (PM) team. PM assigned to the particular client contacts the client for resolution. Major issues require the client to be contacted before the samples can be logged in, such as but not limited to missing COC's, samples being out of hold, insufficient sample volume, bottles received not on COC or out of temperature range. If resolution of the problem is taking time, the samples are labeled as is and placed into refrigerated storage until the problems are resolved. Samples are then removed and processed according to client's instructions. Minor issues identify discrepancies that do not interfere with log-in and/or analysis of the samples, such as 1 of 2 PAH bottles received broken or supplied. The resolution is documented and communicated to sample management for execution.

2.2.5 Once the sample custodian(s) is (are) satisfied with the information on the chain of custody document, the job number is generated from Receipt access-based utility with the next available SGS - Orlando sequential job ID in FXXXXXX convention.

2.2.6 First technician arranges samples on the counter in the order of CoC. Every different point of collection must have a different fraction number, i.e. -1, -2, etc. The assigned fraction number must be written on the chain of custody, to the left of the line identifying the point of collection (Client ID) unless there is insufficient space. The custodian then assigns a unique sample identifier to each sample container, i.e. FAXXXXX-1.4, where 4 is a unique container designation.

2.2.7 The same technician enters samples in the sample location database and prints the labels for the samples. A second technician then attaches the labels to the samples and re-verifies sample client ID and Lab fraction number against CoC. After all the steps in Sec. 3 are completed, first technician closes the Sample Receipt Confirmation Form and second technician reviews it for completeness and accuracy of recorded information.

2.2.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers

2.2.8 **After Hours Delivery Procedure**. Upon return to the lab SGS - Orlando-employed couriers will visually inspect the coolers and add ice if needed. Coolers will then be placed into Refrigerated storage until Sample Receiving Technicians can process the coolers. Sample Receiving technicians will arrive first thing in the morning to verify Short Holds, Rushes etc as per sec. 3.1.5 and 3.1.6.

2.3 When assigning a job number, the following information from the chain of custody is entered in the Access Receipt utility:

2.3.1 SGS - Orlando Assigned Job #
2.3.2 Client Name
2.3.3 Project Name
2.3.4 Date and Time Samples Received.
2.3.5 # of coolers Received.
2.3.6 Courier Information
2.3.7 Technician Initials

2.4 The sample custodian then checks the samples' preservation, except for the volatile samples, which are checked by the analyst after the sample is analyzed. Should a sample be received preserved incorrectly the following actions are taken:

2.4.1 pH and residual chlorine: For samples requiring preservation (HNO3, H2SO4, NAOH and NAOH/Zn Acetate) each container is tested by applying the sample with disposable capillary to narrow-range pH paper. Residual chlorine presence/absence is measured using potassium iodide/starch paper in all samples with EPA 600-series methods indicated on CoC and samples originated in North Carolina (one bottle per well). 45-ml VOC vials are exempt from this procedure and are being tested in the lab after the requested tests are completed (purge-and-trap GC and GC/MS, TOC/TC and EPA 504/8011).

2.4.2 Pesticides/PCB's/Semivolatile Organic aqueous samples with residual chlorine present: Immediately request an appropriate amount of 8% sodium thiosulfate solution to be prepared by WetChem department. Segregate affected samples on a cart in a walk-in cooler until solution is received. Add 1 ml of 8% sodium thiosulfate solution per 1liter (0.008%) to all containers except VOA. Record event on Sample Receipt Confirmation Form and in preservative adjustment log.

2.4.3 Organochlorine pesticides and PCBs by EPA 608 - samples that are not extracted within 72 hours of collection need to have pH checked and adjusted, if necessary, to a pH within 5.0-9.0 using H2SO4 or NaOH. Coordinate with Extraction department.

2.4.4 Cyanide is preserved to pH ≥ 12 using 10N NaOH, prepared by WetChem personnel.

2.4.5 Sulfide is preserved to pH ≥ 9 using 10N NaOH and Zn acetate, prepared by WetChem personnel.

2.4.6 Aqueous samples for metals are preserved to pH ≤ 2 with nitric acid, prepared by WetChem Personnel. These samples are marked with colored label "**Metals Sample Received Unpreserved. Preserved Date_____Time_____ Analyze after 24 hours".** For correctly preserved aqueous metals sampling date and time from COC is recorded as date and time of preservation.

2.4.7 Aqueous samples for TRPH and some WetChem parameters are preserved to a pH of ≤2 with H2SO4, prepared by WetChem Personnel.

2.4.8 To avoid using expired preservatives, in the beginning of the calendar month obtain no more than 100 ml of currently used preservative reagents from Shipping area, appropriately label the container with reagent identity and expiration date and discontinue its use at the end of the month. Turn unused portion to the Waste room for further disposal.

2.5 Incorrectly preserved samples have the proper amount of preservative added, upon confirmation from PM or client, volume added is recorded on the Sample Receipt Confirmation form and in preservative adjustment log. The same volume and type of preservative is then added to the Equipment Blank and/or Field Blank, regardless of pH reading. Volume added is recorded on the Sample Receipt Confirmation form and in the preservative adjustment log. Also see Sec. 3.4.5.

Job Number, Sample ID, Bottle Number, Parameter, Preservative Type, Preservative Lot, and Amount of Preservative Added, Date/Time Added and the technician's initials.

2.6 All bottles must be labeled. Each bottle will be labeled both on the cap and on the bottle. . The labels are generated by the electronic sample receipt log. The following information is entered into the electronic log:

2.6.1 Job #:
2.6.2 Client Name and Project
2.6.3 Date and time samples were received.
2.6.4 The number of coolers received
2.6.5 The temperature of each cooler
2.6.6 Initials of custodian logging in the job
2.6.7 Number of samples
2.6.8 Number of bottles
2.6.9 Bottle type
Preservative by code. From pull down menu in the receiving app.
2.6.10 Bottle storage location
2.6.11 Department to do the analysis
2.6.12 The information is saved and labels can be printed.

2.7 The following information must be on the bottle:

2.7.1 The sample number and bottle number
2.7.2 Storage location
2.7.3 The preservative used during sampling as indicated on the chain

2.8 The samples must be placed in their assigned locations and kept at above freezing and below 6.0°C until preparation and/or analysis. Water samples preserved with HNO_3 for metals analyses are stored at room temperature. Access to the area is limited.

2.9 The original chain of custody and any additional documented information relative to the job isthen placed in a bin in receiving for the Login personnel to pick up for entry into LIMS.

2.10 **Foreign samples** are referred to samples originated outside of continental United States. These samples must be segregated from domestic samples in storage, processing and disposal. Objective of such segregation is to keep agricultural pests and pathogens from entering continental US territory and interfering with animal and plant health.

2.10.1 Foreign Samples shall be shipped in securely closed watertight containers and free of debris and macro organisms (insects, mollusks, worms, ticks and mites).

2.10.2 Foreign samples are stored in lockable cage in WI#3 to prevent accidental disposal. This cage is clearly marked *for foreign samples only*. Sample labels are colored green to stand out in the lab departments.

2.10.3 Keep lids tightly closed while in storage.

2.10.4 All unconsumed samples and containers must be separately collected for disposal. SGS - Orlando employs outside contractor to sterilize and dispose of foreign samples – see SOPs SAM108 and SAM109, current revision.

3.0 SAMPLE STORAGE TEMPERATURE AND CROSS-CONTAMINATION MONITORING

3.1 While in the laboratory, samples shall be stored in limited-access, temperature –controlled areas. Refrigerators shall be monitored for temperature daily. Acceptance criteria for the temperature of refrigerator is 0.5 to 6.0 °C * and is listed in the refrigerator log. Thermometers that have been calibrated with a NIST traceable thermometer monitor all cold storage areas. As indicated by the finding of the calibration, a correction factor is applied to each thermometer for a face value. Records that include acceptance criteria shall be maintained.

*According to TNI 2009 and 2016, V1M2, sec. 5.8.9.a.i) temperature should be above freezing point and below 6.0°C, when specified storage temperature is 4°C. Lowest temperature that can be practically read above freezing point is 0.5°C.

3.2 Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Acceptance criteria for the temperature of a volatile refrigerator is 0.5 to 6.0 °C and is listed in the refrigerator's log. VOC Soil freezers are maintained between –10.0°C and -20.0°C per SW-846 5035A. For further details refer to SOP QA004, current revision.

3.3 Sample storage area for volatile organics shall be monitored for cross contamination using refrigerator blanks. Refrigerator blanks shall be analyzed every other week.

3.3.1 If contamination of the refrigerator is confirmed, the samples must be removed from the refrigerator and placed in coolers with ice, or in alternate refrigerated storage.

3.3.2 All samples received after the date of the last clean refrigerator blank must be checked for the same contaminants. If present, they must be reported and flagged with a qualifier indicating possible lab contamination.

3.3.3 The source of the contamination must be located and removed.

3.3.4 A new refrigerator blank is then placed in the refrigerator and analyzed after 24 hours.

3.3.5 Samples may be returned to the refrigerator when all contaminants are removed as indicated by the analysis of a refrigerator blank without contamination.

4.0 DOCUMENTATION

All samples received by SGS - Orlando must come with a chain-of-custody (COC). Special attention shall be paid to client-specific COCs.

SGS - Orlando personnel MUST record dates and time in **mm/dd/yy 24:00** format, and both observed and corrected temperatures.

Current revisions of forms and label templates used in sample receipt process are maintained as controlled documents in limited access directory on LAN.

Attachment I

SHORT HOLD NOTIFICATION FORM **JOB #________________**

HOLD TIME	**ANALYTE**	**CHECK COC**	**COMMENTS**
ASAP	RedOx		
	Bacteria- Total Coliform/Fecal Coliform		
24 hrs	XCr / Hexachrome / Cr +6		
	Dissolved/Filtered Metals		
	Odor		
	Salinity (SCON+ Field Temp & Presure)		
48 hrs	BOD		
	CBOD		
	MBAS		
	Turbidity		
	Color		
	Nitrate (NO3)		
	Nitrite (NO2)		
	TN (NO2/NO3)		
	OPO4 / Orthophos		
	SS (Settleable Solids)		
	Chlorophyl A (Subcontract)		
72 hrs	Acrolein/Acrylonitrile (VOA from Alaska)		
	Formaldehyde (Subcontract)		
7 days Only for samples received after 5 days	Unpreserved Voa Vials		
	TDS/TSS/TS		
	Sulfide		
	8141 pesticides in soil		
	All the Water extractables		
	Soils		
48 Hours	5035 Field Kit (DI vials)		
	Encore Sampler VOA/VPH/GRO		
	Soil Jar (Bulk Sample) VOA/VPH/GRO		
	NO2/NO3 from WV (IC analysis)		

Relinquished by:______________________Date/Time relinquished:_______________

Received by:__________________________Date/Time received:__________________

APPENDIX F.5

LABORATORY – STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE

Remote Operations: Set Up, Operation, Shut Down

SOP No.: 13 Revision 1 Date: May 14, 2016

1.0 PURPOSE

The purpose of this SOP is to establish the overall safe practices and procedures for the set up, operation, and shut down of remotely controlled heavy equipment.

2.0 SCOPE AND APPLICATION

This SOP applies to Robotics Fabrication, Inc. (RFI) personnel involved in remote heavy equipment operations that have been properly trained and annotated on the RFI Equipment Operators list.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration (OSHA) established standards and requirements. Refer to the site or project-specific Health and Safety Plan for relevant health and safety requirements.

Personnel who conduct remote heavy equipment operations must document evidence to the RFI On Site Supervisor (OSS) that they have read and understand these procedures by completing the SOP Acknowledgement Sheet, (**Attachment 1**) This documentation shall be retained in the project file.

Any deviation from the procedures specified in this SOP will be approved by the RFI President, William A. Lewis prior to implementation.

Prior to daily operations, all equipment will be checked out using the Equipment Checkout Sheet, **Attachment 2**.

4.0 GENERAL SAFETY GUIDELINES

All personnel shall remain a minimum of 35 feet from any piece of remotely controlled heavy equipment when not engaged in MEC operations. A piece of heavy equipment is determined to be in a remote status when the on board Remote and Actuator switches are in the ON position and the engine is running. There are two (2) ways to place the equipment in a Standby status.

1. Placing the Ready/Standby switch on the operator’s handheld controller to the Standby position.
2. Turning the equipment on board Actuator switch to the OFF position.

Prior to approaching equipment in a Remote status, the operator must first lower all buckets/blades to the ground and place the Ready/Standby switch in the Standby position.

Only one person shall approach a piece of equipment in a Remote status for the purpose of placing the Actuator switch in the OFF position, thus putting that piece of equipment in a Standby status.

An E-STOP button is installed on each piece of remote heavy equipment for the purpose of stopping all equipment functions instantaneously in the event of an emergency situation.

An E-STOP button is programmed on each operator's handheld controller for the purpose of stopping all equipment functions instantaneously in the event of an emergency situation.

5.0 PROCEDURES

This section outlines the proper procedures to be used during set up and operation of remotely controlled heavy equipment.

5.1 SET UP

The RFI Remote System consists of an Operator Control Unit (OCU), an Esteem Radio Network, and a Vehicle Interface mounted on each piece of heavy equipment.

5.2 OPERATOR CONTROL UNIT (OCU) SET UP

The OCU consists of the following items: Laptop Computer, Handheld Controller, POE Power Injector, Video Monitor, Esteem Base Radio w/ Antenna and associated cables and power cords.

1. **OCU Connections:**

    a. Connect the antenna to the Esteem Base Radio. The antenna must match the frequency of the radio set being used. **NOTE: If the repeater is NOT required in the network, use the Repeater Radio as the Base Radio.** Attach the radio to the Antenna Mast. Connect the radio to the POE Power Injector with a suitable length Ethernet Cable to allow proper positioning of the radio and mast assembly. The Ethernet Cable will be connected to the Radio using the 10/100 port closest to the green 12VDC connector and to the LANOUT/PWR port on the POE Power Injector. The POE Power Injector may now be plugged in to a 120VAC outlet to power the radio. **WARNING: Never apply power to a radio without an antenna attached. Severe damage to the radio will occur.**

    b. Connect the LAN IN port of the POE Power Injector to the Laptop with a suitable length Ethernet Cable.

    c. Connect the Video Monitor to the Laptop computer using a suitable length HDMI cable.

    d. Connect the Handheld Controller to the Laptop computer using the attached USB cable.

    e. Power up the Laptop computer and Video Monitor, open the RFI OCU program and select the piece of remote heavy equipment being used from the pulldown menu.

5.3 REPEATER RADIO STATION SET UP

The Repeater Radio Station consists of a Esteem Repeater Radio w/ Antenna, a Mast Assembly, POE Power Injector, Generator and associated cables and power cables.

1. **Repeater Radio Station Connections:**

   a. Connect the Antenna to the Esteem Repeater Radio. The Antenna must match the frequency of the radio set being used. Attach the radio to the mast assembly. Connect the POE Power Injector to the Repeater Radio using a suitable length of Ethernet cable to allow for proper positioning of the radio and mast assembly. The cable will be connected to the radio 10?100 port closest to the green 12VDC connector on the radio and the LANOUT/PWR port on the POE Power Injector. The POE Power Injector may now be plugged in to a 120VAC power outlet (generator) to power the radio. **WARNING: Never apply power to a radio without an antenna attached, Severe damage to the radio will occur.**

   b. Position the Repeater Radio/Antenna Mast Assembly in a location within direct line of sight to the Base Radio/Antenna Mast Assembly and the location the remote heavy equipment will be operated in.

5.4 REMOTE EQUIPMENT SET UP

The Remote Heavy Equipment portion of the package consists of the piece of heavy equipment being used with an installed Vehicle Interface Unit, Esteem Vehicle Radio w/ Antenna, AXIS Video Server, Cameras (up to 4), an E-STOP Switch, Remote Switch and Actuator Switch.

1. **Remote Equipment Connections:**

   a. Connect the Antenna to the Esteem Vehicle Radio. The antenna must match the frequency of the radio set being used. Mount the Vehicle radio inside the cab of the vehicle. Connect the pre-wired power cable to the green 12VDC power port on the radio. Connect the radio to the SBRIO board in the installed Vheicle Interface unit using a suitable length of Ethernet cable. The Ethernet cable will be connected to the 10/100 closest to the green 12VDC port on the radio and the Ethernet port on the SBRIO board. Also connect the vehicle radio to the AXIS Video Server with a suitable length of Ethernet cable. The Ethernet cable will connect to the second 10/100 port on the radio and the Ethernet port on the AXIS Server. Connect the pre-wired power cable to the power port on the AXIS Video Server. Connect up to 4 cameras to the Video ports on the XAIS Video Server using the BNC connectors on the camera cables. **WARNING: Never apply power to a radio without an antenna attached. Severe damage to the radio will occur.**

   b. Power is applied to the Vehicle Interface unit and all installed equipment by switching the Remote and Actuator switches, installed on the outside of the equipment, to the ON position.

6.0 SYSTEM START UP AND OPERATION

Only RFI personnel who are properly trained and annotated on the RFI Equipment Operators List will perform these procedures.

1. Set up the Remote System Network and prepare the equipment IAW Chapter 5 of this SOP.
2. Locate the E-STOP, Remote and Actuator Switches on the equipment.
    a. The assistant will twist or pull the Red Knob on the E-STOP switch CLOCKWISE or OUT to ensure the E-STOP is deactivated.
    b. The assistant will place the Remote Switch in the ON (up) position, This will supply power to the SBRIO board and allow remote connection between the equipment and the OCU. At this time the assistant will step away (minimum 35 feet) from the vehicle.
    c. Once Remote Communications are established at the OCU, have the operator start the equipment remotely by activating the Engine Start switch on the handheld controller.
    d. The assistant will again approach the equipment and place the Actuator to the ON (up) position and move clear of the vehicle. Placing the Actuator switch to the ON position will allow hydraulic flow to the equipment in response to any Operator input on the handheld controller. The equipment is now in a Remote status.
    e. Once clear of the vehicle, have the operator place the Ready/Standby Switch on the handheld controller to the Ready position and test the operation of all functions.
    f. In the event that any operator inputs do not result in an appropriate function at the equipment, the equipment and Remote System Network will be shut down and troubleshooting will take place to discover the cause of the malfunction and the corrective action will be taken to repair the System prior to operating the equipment remotely.
    g. Upon completion of a successful operational functions test, the equipment may begin remote operations.

6.1 SYSTEM SHUT DOWN

At the completion of the daily Remote operations, the system will be shut down as follows.

1. Park the equipment in a clear area to allow for Daily Preventive Maintenance and inspection.

    a. The operator will place the Ready/Standby switch on the handheld controller in the Standby position.
    b. The operator will stop the engine by activating the E-STOP switch on the handheld controller.
    c. The assistant will place the Actuator and Remote switches on the equipment to the OFF (down) position.

2. Inspect the equipment for any damage or necessary repairs and perform Daily Preventive Maintenance following the procedures in the Manufacturers Maintenance /Operation Manual.
3. Refuel and secure the equipment.
4. Power down the OCU and Repeater Station (if used) and secure all equipment.

7.0 DAILY PREVENTIVE MAINTENANCE

Daily preventive maintenance will be performed JAW the Manufacturers Maintenance/Operation Manual for each piece of equipment.

8.0 ATTACHMENTS

Attachment I SOP Acknowledgement Form
Attachment 2 Equipment Safety Inspection Checklist

Date 5-14-17

1 1am A. ew1s
President, Robotics Fabrication, Inc.

Attachment 1

SOP ACKNOWLEDGEMENT SHEET

Supervisors Statement

I have read and understand this SOP. To the best of my knowledge, the activities described in this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all personnel assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure that the SOP contains current procedures. If a change to the SOP is necessary, I will ensure that the process is stopped until the SOP is revised and approved. If unexpected safety, health or environmental hazards are found, I will make sure that the process is stopped until the hazards have been eliminated.

Senior UXO Supervisor ______________________

Date ______________________

Workers Statement

I have read this SOP an I have received adequate training to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or I encounter an operation that I cannot perform IAW this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name

Worker's Name	Date	Supervisor's Name

Attachment 2
EQUIPMENT SAFETY INSPECTION CHECKLIST

Equipment Safety Inspection Checklist

MMR Form 23

SOP No.: 12 Revision No.: 01 Date: Sept 2, 2016

Date:
Time:
SSHO:
SUXOS:

Site Name/Location:
Contract Number:

Equipment Make/Description:
Model:
Serial Number:

Place an "X" mark in the appropriate column to indicate that the item passed or failed inspection. If an item failed inspection, describe the discrepancy and the Corrective Action taken in the "Discrepancy/Comments" column. If item does not apply to equipment being inspected enter "NA".
All listed items must have a response.

Item	Pass	Fail	Discrepancies/Comments
Emergency response route maps/phone numbers			
Service brakes			
Emergency brakes			
Parking brake			
Brake lights			
Back-up alarm/warning signal			
Horn			
Tires			
Spare tires			
Spare tire changing equipment			
Steering			
Seat belt			
Operating controls			
Communications			
Fire extinguisher			
Head and tail lights			
Turn signals			
Mirrors			
Windshield			
Windshield wipers and washers			
Coupling devices			
Guards for moving parts			
Outrigger/stabilizers			
Brake - hydraulic			
Brake fluid level/leaks			
Hydraulic fluid levels/leaks			
Engine oil level/leaks			
Engine coolant level/leaks			
Roll Over Protection System (ROPS)			

Item	Pass	Fail	Discrepancies/Comments
Falling Object Protection System (FOPS)			
Fuel level/Leaks			
Safety lever			
Transmission fluid level/Leaks			
Turrett gear oil level/Leaks			
Track tension			
Fire suppression level			
General overall condition			
Other			

Inspection conducted by:

Signature:

Discrepancies corrected by:

Date:

STANDARD OPERATING PROCEDURE

HEAVY EQUIPMENT OPERATION

SOP No.: 14 Revision 0 Date: Sept 14, 2016

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide Robotics Fabrication, Inc. (RFI) employees the minimum safety and health requirements and procedures applicable to the conduct of operations involving the use of heavy equipment.

2.0 SCOPE AND APPLICATION

This SOP applies to all site personnel, to include contractor and subcontractor personnel involved in the conduct of heavy equipment operations. This SOP is not intended to contain all requirements needed to ensure regulatory compliance. Consult the documents listed in Section 3.0 of this SOP for additional compliance issues.

3.0 REGULATORY REFERENCES

The following Occupational Safety and Health Administration (OSHA) standards and U.S. ARMY Corps of Engineers (USACE) requirements directly apply to the conduct of operations associated with this SOP.

1. Applicable parts of OSHA Construction Industry Standard 29 CFR, Part 1926, Subpart O.
2. Applicable parts of OSHA General Industry Standard 29 CFR, Part 1910, Subpart N.
3. USACE EM 385-1-1, Section 16.
4. Manufacturers Operation Manuals for the equipment being used.

4.0 RESPONSIBILITIES

4.1 PROJECT MANAGER

The Project Manager (PM) shall be responsible for ensuring the availability of the resources needed to implement this SOP, and shall ensure that this SOP is incorporated into plans, procedures and training for sites where this SOP is to be implemented.

4.2 RFI ON-SITE SUPERVISOR (OSS)

The RFI On-Site Supervisor (OSS) will ensure that this SOP is trained and implemented in heavy equipment operations and that all personnel will sign the SOP Acknowledgement Sheet (**Attachment 1**). The OSS will also ensure that relevant sections of this SOP are discussed in the daily tailgate safety briefings, and that information related to its daily implementation is documented in the Daily Report. The OSS will also be responsible for daily inspection of site operations and conditions to ensure their initial and continued compliance with this SOP and other regulatory guidelines.

4.3 RFI TEAM LEAD

The RFI Team Lead shall be responsible for the daily inspection and maintenance of all heavy equipment being operated by members of his or her team. They will direct team personnel in the daily duties involving daily checkout of the equipment, safe operation, preventive maintenance, refueling and cleaning of the assigned equipment. The RFI Team Lead will report any issues directly to the OSS. Daily Inspections of the equipment will be performed using the Equipment Checkout Sheet (**Attachment 2**).

5.0 PROCEDURE

All personnel, including contractor and subcontractor personnel involved in heavy equipment operations shall be familiar with the potential safety and health hazards associated with the conduct of this operation, and with the work practices and control techniques to be used to reduce or eliminate these hazards. In the event that ordnance and explosives are present at the work site, the procedures for anomaly avoidance and soil excavation will be presented in the Work Plan and the Site Safety and Health Plan.

5.1 SAFETY HAZARDS AND OPERATIONAL CONTROL TECHNIQUES

1. The operation of heavy equipment shall be limited to authorized personal specifically trained in its operation.
2. A competent person shall visually inspect heavy equipment daily, prior to operation, and report any abnormalities/deficiencies to the RFI OSS.
3. The operator shall use the safety devices provided with the equipment, including seat belts and backup warning indicators, and horns shall be operational at all times.
4. While in operation, all personnel nt directly required in the area shall keep a safe distance from the equipment.
5. The operator’s cab shall be kept free of all non-essential items, and all loose items shall be secured.
6. Personnel shall avoid moving into the path of operating equipment, and areas blinded from the operator’s vision shall be avoided.
7. Heavy equipment requiring an operator shall not be permitted to run unattended.
8. Except for equipment designed to be serviced while in operation, all equipment shall be shut down and positive means taken to prevent its operation while repair or servicing is being conducted.
9. All equipment shall be secured at the end of the day, or when not in operation, with the blades/buckets of earth moving equipment placed on the ground.
10. Heavy equipment shall be shut down prior to and during refuel operations.
11. Personnel shall not work or pass under the buckets or booms of equipment in operation.
12. Each piece of heavy equipment shall be equipped with at least one dry chemical fire extinguisher having a minimum UL rating of 5-B:C.
13. Additional riders shall not be permitted to ride on the equipment, unless it is specifically designed for that purpose (i.e. there is an additional seat and seat belt).
14. Three (3) points of contact will be used by the operator whenever entering/exiting the equipment.

5.2 SAFETY AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following safety measures and personal protective equipment shall be used in preventing or reducing exposures associated with heavy equipment operations. These requirements will be implemented, unless superseded by site-specific requirements stated in the Site Safety and Health Plan.

1. Heavy equipment operators will have received training which addresses the safe operation of the equipment to be used.
2. Heavy equipment operators shall wear the level of PPE specified in the site-specific Safety and Health Plan.

6.0 ATTACHMENTS

Attachment I SOP Acknowledgement Sheet
Attachment 2 Equipment Safety Inspection Checklist

William A Lewis
President, Robotics Fabrication, Inc.

9-14-16
Date

Attachment 1

SOP ACKNOWLEDGEMENT SHEET

Supervisors Statement

I have read and understand this SOP. To the best of my knowledge, the activities described in this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all personnel assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure that the SOP contains current procedures. If a change to the SOP is necessary, I will ensure that the process is stopped until the SOP is revised and approved. If unexpected safety, health or environmental hazards are found, I will make sure that the process is stopped until the hazards have been eliminated.

Senior UXO Supervisor

Date

Workers Statement

I have read this SOP an I have received adequate training to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or I encounter an operation that I cannot perform IAW this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name

Worker’s Name	Date	Supervisor’s Name

ATTACHMENT 2
EQUIPMENT SAFETY INSPECTION CHECKLIST

STANDARD OPERATING PROCEDURE

Sifting Operations

SOP No.: 15 Revision 01 Date: May 5, 2017

1.0 PURPOSE

The purpose of this SOP is to establish the overall safe practices and procedures for the setup, operation, and shut down of sifting equipment.

2.0 SCOPE AND APPLICATION

This SOP applies to Robotics Fabrication, Inc. (RFI) personnel involved in sifting operations that have been properly trained and annotated on the RFI Equipment Operators list.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration (OSHA) established standards and requirements. Refer to the site or project-specific Site Safety and Health Plan (SSHP) for relevant health and safety requirements.

Personnel who conduct sifting operations must document evidence to the RFI On Site Supervisor that they have read and understand these procedures by completing the SOP Acknowledgement Sheet, (**Attachment 1**). This documentation shall be retained in the project file.

Any deviation from the procedures specified in this SOP will be approved by the RFI President, William A. Lewis prior to implementation.

Prior to daily operations, all equipment will be checked out using the Equipment Safety Inspection Checklist, **Attachment 2**, and the Manufacturer's Operations Manual.

4.0 GENERAL SAFETY GUIDELINES

Only trained personnel should be allowed to install, set up, operate, maintain and disassemble this equipment. Make sure that a copy of the Manufacturer's Operation Manual is available for any persons installing, using, maintaining or repairing this equipment. Emergency Stop (E-STOP) buttons and remote E-STOP are installed on each sifting and screening machine in various locations. All personnel involved in operations must be familiar E-STOP locations and operations for the purpose of stopping all equipment functions instantaneously in the event of an emergency situation.

Make sure that Safety Instructions and Safety Labels are attached to the equipment and that they are clean and visible at all times.

Always Switch Off and Lock Out this equipment prior to making any adjustments or repairs.

Ensure all PPE is worn by personnel, which may include work gloves, eye protection, hard hat, steel toe boots, hearing protection and dust mask while working around this equipment. Site specific PPE requirements will be included in the SSHP.

DO NOT operate this equipment if any safety guards or devices have been removed.

Steps, handrails, tread plates and fixed guards may be present on equipment where personnel are required to climb on these machines. Portable ladders may be used to provide temporary access to the sides of machines, as needed, as specified in the OSHA 3124-12R-2003 and EM 385-1-1.

Always maintain three (3) points of contact whenever climbing on to or off of this or any piece of equipment.

When tracking the equipment, the gradient must never be more than 10 degrees Port to Starboard or 20 degrees Front to Back. The machine must always be on flat, solid ground when operating.

5.0 PROCEDURES

This section outlines the proper procedures to be used during set up, operation, and shutdown of the sifting equipment.

5.1 SET UP

The sifting equipment will be tracked to the operations area and parked on flat, solid ground. The belts will be lowered into the operating position and all safety guards locked in place. Any additional equipment, stackers, hoppers will then be positioned and the machine will be ready for operation.

5.2 OPERATION DESCRIPTION

Material is loaded normally by excavator into the feeder where the material is transferred towards the screen box.

The material passes over the vibrating screen box where smaller material will fall through the top deck and onto the bottom deck.

The larger material that has stayed on the top deck is fed to the tail conveyor and is stockpiled at the rear of the machine (Large Overs).

The smaller material that has fallen through to the bottom deck is transferred either to the left hand side conveyor (Midsize Overs) or falls through to the Fines conveyor and is stockpiled at either side of the machine, using stackers to move the material away from the sifting equipment. Material on the stackers will pass under a cross belt magnet to remove ferrous material from the material stream.

5.3 MACHINE STARTUP

Before starting the machine, it is important that the instructions below are followed:

- Ensure that the manufacturer’s manual is read and understood by the operator.
- **DO NOT** attempt to start the machine until you are aware of all aspects of its operation. Any questions should be referred to your supervisor.
- Check that the machine is in good mechanical condition and that there is no component damage or missing parts.

- Ensure all bolts and fasteners are tight and that all guards are in place with all safety devices operating correctly. NEVER start the machine without guards and/or safety devices.
- Ensure that the feeder, screen box and conveyors are all free of material.
- Remove any tools or equipment from the operational area.
- Ensure all personnel are well clear of the machine, tracks and auxiliary equipment.
- Check all fluid levels.
- Ensure safety pins are in the appropriate positions.
- Ensure all operating levers are in the OFF position.
- Ensure the conveyor belts, skirting rubbers and scrapers are in good condition and working properly.

Engine Start up:

1. Insert ignition key into ignition switch and turn clockwise to the ON position until lights stop flashing and only the battery and oil pressure lights are lit.
2. Turn key further clockwise until the engine starts, then release key.
3. If starting from cold, allow the engine to warm up for 5 minutes before engaging any hydraulics.

Note: When starting the machine in temperatures below freezing, run the screen box for 15 minutes to allow hydraulic oil to reach working temperature. Do not feed material into machine during this time.

4. Using the hydraulic levers at the control panel engage:
    a) Tail Conveyor
    b) Left Hand Mid Side Conveyor
    c) Fines Conveyor
    d) Screen Box
    e) Feed Conveyor (Feed Conveyor Control is a push button on the panel)
5. Set engine speed to 2000 RPM.
6. Begin sifting operations.

5.4 STANDARD MACHINE SHUT DOWN FOR SCREEN PLANT – OTHER THAN E-STOP

Upon completion of sifting operations, the machine will be shut down using the following steps:

1. Ensure that all material has been processed through the machine and that all belts are free and clear of any and all material.
2. Reduce engine speed to idle.
3. Disengage hydraulics in the reverse order of startup. (para 5.3.4 a through e)
4. Allow engine to run at idle for a 5-minute cool down period.
5. Turn ignition key to off and remove key.

5.5 EMERGENCYSHUT DOWN PROCEDURE (E-STOP)

This procedure is used in emergency shut down of the plant for safety or operational concerns.

1. Press E-STOP or remote E-STOP.
2. **DO NOT** approach screening plant until cleared by UXO personnel.
3. Notify UXO Team for assistance.

6.0 DAILY PREVENTIVE MAINTENANCE

Daily preventive maintenance will be performed IAW the Manufacturers Maintenance /Operation Manual for each piece of equipment.

7.0 ATTACHMENTS

Attachment 1	SOP Acknowledgement Sheet
Attachment 2	Equipment Safety Inspection Checklist

5-2-2017

William A. Lewis, P
Robotics Fabrication, Inc.

Date

Attachment 1

SOP ACKNOWLEDGEMENT SHEET

Supervisors Statement

I have read and understand this SOP. To the best of my knowledge, the activities described in this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all personnel assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure that the SOP contains current procedures. If a change to the SOP is necessary, I will ensure that the process is stopped until the SOP is revised and approved. If unexpected safety, health or environmental hazards are found, I will make sure that the process is stopped until the hazards have been eliminated.

____ ____________________________
Senior UXO Supervisor Date

Workers Statement

I have read this SOP an I have received adequate training to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or I encounter an operation that I cannot perform IAW this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name

Worker's Name	Date	Supervisor's Name

ATTACHMENT 2
EQUIPMENT SAFETY INSPECTION CHECKLIST

Safety Equipment Checklist

MMR Form 09

Revision No.: 0 Date: Sept 2, 2016

Equipment	Quantity	Comments
Air Horn		
Burn Blanket		
Burn Kit		
Emergency Eye Wash Station		
Fire Blanket		
Bloodborne Pathogen Kit		
First Aid Kit		
Leather Gloves		
Goggles		
Face Shield(s)		
Welders Gloves		
Welders Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, Drinking		
Automatic Emergency Defibrillator		

Checklist Verification

Disposal Supervisor Signature	Date

APPENDIX G
FIELD FORMS

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APPENDIX G.1

MANAGEMENT – FIELD FORMS

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SUXOS DAILY REPORT

CONTRACT NUMBER		**LOCATION**		**DAY/DATE**		**REPORT NUMBER**	
						1	
YES		NO		YES	#REF!	NO	
Total work hours on site				**TOTAL HOURS**			
Total hours worked from start of project							

Tasks Completed on Site XX

TEAM #	# Grids Completed	MEC Items Recovered	QA Seeds	QC Seeds	LBS of MD	LBS of Non-MD
1						
2						
DGM			TOTAL MDAS TODAY			

Tasks Completed on Site YY

TEAM #	# Grids Completed	MEC Items Recovered	QA Seeds	QC Seeds	LBS of MD	LBS of Non-MD
1						
2						
DGM			TOTAL MDAS TODAY			
			TOTAL BOTH MSA's			

TASKS COMPLETED BY QC/QA TODAY

GRIDS PASSED QC		GRIDS FAILED QC	
GRIDS PASSED QA		GRIDS FAILED QA	

SUXOS DAILY REPORT

CONTRACT NUMBER	LOCATION	DAY/DATE	REPORT NUMBER

CONTRACTOR: TLI				NAME OF SUXOS:			
Weather			Wind:	Temperature:			
				High:		Low:	

PRIME CONTRACTOR/SUBCONTRACTOR WORKFORCE				SUMMARY OF WORK PERFORMED
POSITION	NAME	HOURS	EMPLOYER	
Tech Manager				Site Management/off site
SUXOS				Site Management
UXOQCS				QC Operations
UXOSO				Safety Operations
FOA/Tech 1				FOA/Tech 1
Team 1 UXO T3				Field Operations
UXO T2				Field Operations
UXO T2				Field Operations
UXO T2				Field Operations
UXO T1				Field Operations
UXO T1				Field Operations
UXO T1				Field Operations
Project GEO				Off Site
Site GEO Lead				Field Operations
Geo Assistant				Field Operations
Geo Assistant				Field Operations
Geo Assistant				Field Operations
Geo Assistant				Field Operations

TOTAL WORK HOURS ON JOB SITE TODAY		WERE THERE ANT LOST TIME ACCIDENTS THIS DATE				
CUMULATIVE TOATL OF WORK HOURS FROM PREVIOUS REPORT			YES			NO
		IF "YES", ATTACH SUMMARY OF INCIDENT OR OSHA REPORT				
TOTAL WORK HOURS ON JOB SITE THIS DATE						

SAFETY TOPICS COVERED:

QC INSPECTIONS PASSED:		QA INSPECTIONS PASSED:		
QC INSPECTIONS FAILED:		QA INSPECTIONS FAILED:		

REMARKS/SUMMARY:

THE FOLLOWING GRIDS PASSED TLI QC:

SUXOS DAILY REPORT

THE FOLLOWING GRIDS FAILED TLI QC:							
LOCATION AND DESCRIPTION OF DEFICIENCIES							
DEFICIENCIES CORRECTED:				REPORT #		COMPLIANCE NOTICE #	
SUXOS DESCRIPTION OF ACTIVITES:							
TEAM COMPLETED THE FOLLOWING GRIDS:							
1							
2							
BOLD TEXT INDICATES A REDO GRID							
	# Grids Completed	MEC items	QA Seed	QC Seed	Lbs. MD	Lbs. Non-MD	
1							
2							
DGM							
TLI Safety Officer			DATE	SUXOS			DATE

TLI Solutions Daily *[QC-Safety-SUXOS]* Log
[Site Name & Location]

Date	Time	Event
MM/DD/YY		

Contract #: Task Order #:

Instructions for Completing an TLI Solutions Daily Log

This log is intended to be a continuous table that will extend from page to page. The header, footer, and first row of the table will be carried to each new page, and a running log of the pages will be kept in the footer.

Header: In the header, enter the Project Type along with the city and state (For example: Ft. Hood DMPRC, Ft. Hood, TX).

Date: For the first event entry each day, enter the date in the first row under the previous day's events.

Time: Enter the time of the event in MM/DD/YY format.

Event: Enter the event description.

Contract # / Task Order #: Below the last line of the log, enter the Contract # and Task Order # of the project.

Enter additional time and event information on successive rows. There is no need to enter a new date with every event recorded within a given date since the rows in the date column can be merged at the end of the entries for a given date (see example below).

Date	Time	Event
03/22/01	0700	Event 1
	0730	Event 2
	0800	Event 3
	Etc.	Event 4
	Etc.	Event 5
	Etc.	Event 6
	1630	Event 7
03/23/01	0700	Event 1
	0745	Event 2
	01630	Event 3

Log Table Formatting: To extend the length of the table (i.e., add additional rows) simply place the cursor in the "Event" column of the last row and press the "Tab" key. For simplicity of use, make each new entry in a new line within the table. To merge the rows in the Date column at the end of the day, place your cursor in the row at the start of the day, click left mouse button, drag down and highlight all rows in the date column down to the last entry for the day. Release the left mouse button and, with the cursor over part of the highlighted column click the right mouse button and select "Merge Cells" in the pop-up menu.

MATERIAL DOCUMENTED AS SAFE (MDAS) LOG

Project Name and Physical Location:			Contract Number:		Task Order Number:
Date	**Origin of MDAS**	**Weight Added**	**Weight On Hand**	**Certified**	**Verified**

Name and Signature	Title/Company	Date

Name and Signature	Title/Company	Date

1. DODIC	2. NSN	3. LOT NO.	4. LOCATION	B.	D.
5. DESCRIPTION			A.	C.	E.

6. DATE	7. DOCUMENT NO.	8. ACTION/PURPOSE	9. QUANTITY		10. BALANCE	11. PRINTED NAME
			A. GAIN	B. LOSS		

DA FORM 3020-R, AUG 1989

MAGAZINE DATA CARD

For use of this form, see DA PAM 710-2-1; the proponent agency is DCSLOG

Continued on Reverse

PREVIOUS EDITION IS OBSOLETE

APD LC v1.01

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1. DODIC	2. NSN	3. LOT NO.	4. LOCATION	B.	D.
5. DESCRIPTION			A.	C.	E.

6. DATE	7. DOCUMENT NO.	8. ACTION/PURPOSE	9. QUANTITY		10. BALANCE	11. PRINTED NAME
			A. GAIN	B. LOSS		

REVERSE, DA FORM 3020-R, AUG 1989

MAGAZINE DATA CARD

Use Other Side First

APD LC v1.01

2 3 4	5 6 7			23 24	25 26 27 28 29	45 46 47 48 49 50	51	52 53	54 55 56	57 58 59	60 61	62 63 64	65 66	67 68 69	70	71	72 73	74 75 76 77 78 79 80	1. TOTAL PRICE $0.00	2. SHIP FROM	3. SHIP TO
DOC	IDE	FROM	MOS	UNIT ISS	QUANTITY	SEA SUPPLEMENTARY ADDRESS	SIC	FUND	DISTRIBUTION	PROJECT	PRI	AEOD DEL DRTL	ADV	N	OI	COND	NOT	UNIT PRICE $0.00 DOLLARS $0 CTS 00	DOLLARS $0 CTS 00	4. MARK FOR

& SUFFIX (30-44)

STOCK NO. & ADD (8-22)

UI (23-24) QTY (25-29)
COND CODE (71)
DIST (54-56)
UP (74-80)

U.S. Army Corp of Engineers USACE

TLI Solutions

Container Number

Seal

Certified by:

SUXOS
TLI Solutions Home Office (713) 818-3209
TLI Solutions Field Office (480) 280-6004

Verified by:

QCS/TLI Solutions

5. DOC Date	6. MMPC	7. PRT RATE	8.TYPE CARGO	9. PS		
10. QTY. REC'D	11UP	12. UNIT WEIGHT	13.UNITCUBE	14.LOC	15.SL	

16. PRODUCT CLASSIFICATION NOMENCLATURE

Material Documented as SAFE

17. ITEM NOMENCLATURE

MDAS Metal; Mixed

18. TY CONT	19. NO CONT	20. TOTAL WEIGHT	21. TOTAL CUBE

22. RECEIVED BY	23. DATE RECEIVED

This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials.

DD FORM 1348-1A

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2 3 4	5 6 7			23 24	25 26 27 28 29	45 46 47 48 49 50	51	52 53	54 55 56	57 58 59	60 61	62 63 64	65 66	67 68 69	70	71	72 73	74 75 76 77 78 79 80	1. TOTAL PRICE $0.00	2. SHIP FROM 0	3. SHIP TO
DOC	IDE	FROM	MOS	UNIT ISS	QUANTITY	SEA SUPPLEMENTARY ADDRESS	SIC	FUND	DISTRIBUTION	PROJECT	PRI	AEOD DEL DRTL	ADV	N	OI	COND	NOT	UNIT PRICE $0.00 DOLLARS $0 CTS 00	DOLLARS $0 CTS 00	4. MARK FOR

& SUFFIX (30-44)

STOCK NO. & ADD (8-22)

UI (23-24) QTY (25-29)
COND CODE (71)
DIST (54-56)
UP (74-80)

U.S. Army Corp of Engineers USACE

TLI Solutions

Container Number

Seal

Certified by:

0
SUXOS
TLI Solutions Home Office (713) 818-3209
TLI Solutions Field Office (480) 280-6004

Verified by:

0
QCS/TLI Solutions

5. DOC Date 2/27/2019	6. MMPC	7. PRT RATE	8.TYPE CARGO	9. PS		
10. QTY. REC'D	11UP	12. UNIT WEIGHT	13.UNITCUBE	14.LOC	15.SL	

16. PRODUCT CLASSIFICATION NOMENCLATURE

Material Documented as SAFE

17. ITEM NOMENCLATURE

MDAS Mixed metal

18. FY CONT	19. NO CONT	20. TOTAL WEIGHT	21. TOTAL CUBE

22. RECEIVED BY	23. DATE RECEIVED

This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials.

DD FORM 1348-1A

2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOC | ID | FROM | MOS | UNIT | ISS | QUANTITY | SEA | SUPPLEMENTARY ADDRESS | SIC | FUND | DISTRIBUTION | PROJECT | PRI | AEOD | DEL | DRTL | ADV | N | OI | COND | NOT

1. TOTAL PRICE $0.00
UNIT PRICE $0.00
DOLLARS CTS
$0 00
DOLLARS CTS
$0 00

2. SHIP FROM

3. SHIP TO

4. MARK FOR

& SUFFIX (30-44)

STOCK NO. & ADD (8-22)

UI (23-24) QTY (25-29) COND CODE (71) DIST (54-56) UP (74-80)

Location:
Contractor: TLI Solutions

Container / Seal Identification:
N/A

Certified by:

TLI Solutions Home Office (713) 818-3209
TLI Solutions Field Office (480) 280-6004

Verified by:

5. DOC Date

6. MMPC

7. PRT RATE

8.TYPE CARGO

9. PS

10. QTY. REC'D

11UP

12. UNIT WEIGHT

13.UNITCUBE

14.LOC

15.SL

16. PRODUCT CLASSIFICATION NOMENCLATURE
Non-Munitions Related Scrap Metal

17. ITEM NOMENCLATURE
Metal; Mixed

18. TY CONT

19. NO CONT

20. TOTAL WEIGHT

21. TOTAL CUBE

22. RECEIVED BY

23. DATE RECEIVED

1

This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials.

DD FORM 1348-1A

---

2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOC | ID | FROM | MOS | UNIT | ISS | QUANTITY | SEA | SUPPLEMENTARY ADDRESS | SIC | FUND | DISTRIBUTION | PROJECT | PRI | AEOD | DEL | DRTL | ADV | N | OI | COND | NOT

1. TOTAL PRICE $0.00
UNIT PRICE $0.00
DOLLARS CTS
$0 00
DOLLARS CTS
$0 00

2. SHIP FROM
0

3. SHIP TO
PCD

4. MARK FOR

& SUFFIX (30-44)

STOCK NO. & ADD (8-22)

UI (23-24) QTY (25-29) COND CODE (71) DIST (54-56) UP (74-80)

Location:
Contractor: TLI Solutions

Container / Seal Identification:

0

Certified by:

0
TLI Solutions Home Office (713) 818-3209
TLI Solutions Field Office (480) 280-6004

Verified by:

0

5. DOC Date
1/0/1900

6. MMPC

7. PRT RATE

8.TYPE CARGO

9. PS

10. QTY. REC'D
0

11UP

12. UNIT WEIGHT
pounds

13.UNITCUBE

14.LOC

15.SL

16. PRODUCT CLASSIFICATION NOMENCLATURE
Non-Munitions Related Scrap Metal

17. ITEM NOMENCLATURE
Metal; Mixed

18. FY CONT
0

19. NO CONT
1

20. TOTAL WEIGHT
0

21. TOTAL CUBE

22. RECEIVED BY

23. DATE RECEIVED

2

This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials.

DD FORM 1348-1A

MEC Control Log

Log #	Date	Team	Nomenclature	Qty	Location	DEMO DATE	N.E.W.
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
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42							
43							
44							
45							
			Total MEC Items:	0	TOTALS:	Pounds	Ounces
						0.00	0

APPENDIX G.2

QUALITY – FIELD FORMS

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QUALITY CONTROL 3-PHASE INSPECTION CHECKLIST

	SITE LOCATION				
Report Number	**CONTRACT NO:**			**DATE:**	
Personnel Present					

MOBILIZATION

ITEM	REF	INSPECTION POINT	PREPARATORY			INITIAL			FOLLOW UP		
			YES	NO	NA	YES	NO	NA	YES	NO	NA
1	ESS	Verify Project Kick-Off Safety Briefing was conducted									
2	QAPP/WP	Verify approved and current Work Plan/UFP-QAPP									
3	QAPP/WP	Verify Project Plans reviewed by project personnel									
4	APP/SSHP	Audit medical clearance for completeness and currency									
5	APP/SSHP	Audit personnel training and certification records									
6	APP/SSHP	Verify Site Orientation was conducted									
7	APP/SSHP	Verify Overall Safety and MEC Safety Brief conducted on-site									
8	QAPP/WP	Verify approved and current Work Plan/QAPP on hand									
9	QAPP/WP	Verify Project Plans reviewed and on hand									
10	APP/SSHP	Verify medical clearance for accuracy and on hand									
11	APP/SSHP	Verify personnel certification records on hand									
12	APP/SSHP	Verify all sub-contractor and site visitor records are on hand prior to entering work zone									

SITE PREP MEASUREMENT PERFORMANCE ACTIVITY (CIVIL SURVEY)

ITEM	REF	INSPECTION POINT	PREPARATORY			INITIAL			FOLLOW UP		
1	QAPP/WP	Verify PLS license at start-up									
2	MEC SOP	Verify equipment checks (Geodetic Accuracy) IAW manufacturer instructions are followed monthly for frequently used control points and before use for infrequent points									
3	MEC SOP	Verify equipment checks (Geodetic Funtionality) IAW manufacturer instructions are followed at the start and end of day, when RTS or GPS is used. Positional error for the RTK GPS at a known/temporary monument will not exceed ± 0.328 ft. (10 cm) accuracy									
4	QAPP/WP	Verify PLS provides documentation annotating accuracy at the end of field work									
5	QAPP/WP	Verify PLS has installed boundaries within ± 10 cm accuracy									
6	QAPP/WP	Verify PLS has installed four control points within prescribed boundary									
7	MEC SOP	Ensure a UXO Tech II escort is provided									

SITE PREP MEASUREMENT PERFORMANCE ACTIVITY (BRUSH CLEARANCE)

ITEM	REF	INSPECTION POINT	PREPARATORY			INITIAL			FOLLOW UP		
1	QAPP/WP	Verify brush is removed as required by DGM activities through periodic inspections									
2	APP/SSHP	Ensure personnel are properly trained in removing brush and operating equipment									
3	APP/SSHP	Ensure personnel are outfitted with the appropriate personnel protective equipment									
4	APP/SSHP	Verify personnel are observing a minumum safe distance when clearing brush									
5	QAPP/WP	Verify cut brush is mulched and spread thinly or placed outside the DGM areas and remain within the boundary									

SITE PREP (EXPLOSIVE STORAGE)

ITEM	REF	INSPECTION POINT	PREPARATORY			INITIAL			FOLLOW UP		
1	EMP/ESP	Verify one sited BATF Type II magazine for donor explosives not to exceed 100 lbs. Net Explosive Weight (NEW)									
2	EMP/ESP	Verify second sited BATF Type II magazine collocated with donor storage magazine to store MPPEH/MEC items that are safe to move. The storage limits will be IAW final ESP and final EMP (Appendix F).									
3	EMP/ESP	UXOQCS and a licensed electrician will inspect the magazines to ensure proper configuration and grounding connections. This will be documented on a DQCR and the electricians report will be maintained onsite.									
4	EMP/ESP	UXOQCS and SUXOS conducts and documents weekly inspections and receipt of donor explosives.									
5	MEC SOP 18-05-00	UXOQCS or designee conducts weekly inspections of the magazines and documents the process on a QCSR.									
6	MEC SOP 18-05-00	Verify weekly vegetation control procedures are conducted inside the fence as well as 50-feet in all directions outside the fence.									
7	MEC SOP 18-05-00	Verify no smoking signs are properly posted on the outside of the fence, in all directions.									

8	MEC SOP 18-05-00	Verify that two 10-lb fire extinquishers are on hand and serviceable									
9	MEC SOP 18-05-00	Verify donor explosives are on-site and secured as necessary to dispose of MEC/MPPEH identified during field activities.									
10	EMP/ESP	Ensure the BATF Federal Explosive License/Permit is current and posted in the site office.									
11	EMP/ESP	Ensure all magazine locks meet or exceed BATF requirements									

SITE PREP OF WORK AREAS AND STAGING AREAS (CANTONMENT)

1	QAPP/WP	Verify work zones and exclusion zones been properly plotted									
2	APP/SSHP	Verify emergency response procedures have been identified									
3	SSHP	Verify communications have been identified									
4	QAPP/WP	Verify equipment and materials are accounted for and IAW the listed reference									
5	QAPP/WP	Verify teams' first-aid kits are available and serviceable									
6	QAPP/WP	Verify secure parking for vehicles									
7	APP/SSHP	Verify break and rest areas are established, and appropriately equipped with a hand washing station and debris collection containers.									
8	APP/SSHP	Verify toilet facilities available?									
9	QAPP/WP	Verify secure storage for equipment									
10	QAPP/WP	Verify all personnel are properly trained and that the training is documented prior to entering the work zone for the first time									
11	DOL	Verify all employee rights posters are on hand and properly posted in site office									

SITE PREP OF WORK AREAS AND STAGING AREAS (FIELD)

1	QAPP/WP	Verify Tailgate Safety Briefing has been conducted									
2	QAPP/WP	Verify work zones and exclusion zones been properly established and marked									
3	APP/SSHP	Verify notifications have been made for emergency response services									
4	SSHP	Verify communications have been established									
5	QAPP/WP	Verify all equipment, vehicles and materials are accounted for, properly staged and secure									
6	QAPP/WP	Verify teams' first-aid kits on hand									
7	APP/SSHP	Confirm break and rest areas are established, and appropriately equipped with a hand washing station and debris collection containers.									
8	APP/SSHP	Confirm toilet facilities available?									

ITEM	REF	INSPECTION POINT	PREPARATORY			INITIAL			FOLLOW UP		
			YES	NO	NA	YES	NO	NA	YES	NO	NA

DIGITAL GEOPHYSICAL MAPPING (DGM) (AGM) (REAC) (DATA MANAGEMENT)

1	QAPP/WP	Verify that an approved PLS survey control point is used									
2	GEO SOP	Verify that the GSV is in place and constructed IAW SOP									
3	QAPP/WP	Verify that the IVS Letter Report is provided to the USACE QA Geophysicist for approval at least one week prior to data collection									
4	QAPP/WP	Verify that the final IVS Letter Report is provided to for submittal									
5	GEO SOP	Verify that GEO provides the Initial IVS Technical Memorandum detailing IVS setup, surveys and results after performance of the initial dynamic IVS.									
6	QAPP/WP	Verify that the Blind Seeds are in place and recorded; ensuring one seed is covered per collection day									
7	SOP	Verify that the daily checks of the instruments are completed									
8	GEO SOP	Verify DGM/AGM teams are perform and document a Static Repeatability check at the start and end of each day within 10% of the expected response									
9	QAPP/WP	Verify that transects are spaced 20 feet and providing for 50% coverage at each Area of Concern (AOC)									
10	QAPP/WP	Verify that the teams are collecting data IAW the QAPP and SOP									
11	QAPP/WP	Ensure coverage plots/daily inspection reports are provided for verification indicating 100% coverage has been achieved at project specific line spacing									
12	QAPP/WP	Verify the Project Database reflects seeds are detected and meet the response and accuracy MQOs									
13	QAPP/WP	Verify DGM data meets all applicable MQOs for verification and validation									
14	QAPP/WP	Verify Data Processing Checklist is completed for each data set for verification and validation, to include all raw processed data									
15	QAPP/WP	Verify all DGM data meets the applicable MQOs, and that all Checklists, Forms, Project Database and Blind Seed Documentation is provided for verification									
16	GEO SOP	Verify reacquired target location offset and amplitude is recorded by field team and added to project database; offset must be less than 1m.									

17	QAPP/WP	Ensure 10% of no-finds are verified by UXOQCS or designee and added to Project Database									

FIELD OPERATIONS START-UP

1	QAPP/WP	Verify all team members have reviewed the Work Plan/QAPP									
2	MEC SOP	Verify all team members reviewed reference for Surface Sweep Operations?									
3	MEC SOP	Verify all team members reviewed reference for Intrusive Operations?									
4	QAPP/WP	All Team Members qualified in accordance with referenced WP/QAPP section?									
5	APP/SSHP	Ensure all personnel read and signed all AHAs associated with the surface clearance									
6	QAPP/WP	Verify Geophysical Equipment is calibrated IAW the listed reference									
7	GEO SOP	Verify that the Instrument Verification Strip is in place and IAW the ESS									
8	QAPP/WP	Verify all personnel and equipment process through the ITS, with a 100% detection rate to successully pass the certification process; document results									
9	QAPP/WP	Verify Tailgate Safety Briefing has been conducted									
10	QAPP/WP	Verify SUXOS or UXOSO completed notifications prior to commencing operations									
11	QAPP/WP	Verify approved and current QAPP on-site									
12	QAPP/WP	Confirm all Team Members qualified in accordance with referenced section?									
13	QAPP/WP	Confirm all team members have reviewed the QAPP/Work Plan									
14	MEC SOP	Verify all team members reviewed reference for Surface Sweep Operations?									
15	MEC SOP	Confirm all team members reviewed reference for Intrusive Operations?									
16	APP/SSHP	Confirm all personnel have read and signed all AHAs associated with the surface clearance?									
17	APP/SSHP	Verify Team Members properly outfitted with appropriate PPE									
18	SSHP	Are personal hygiene and decontamination procedures followed?									
19	EPP	Are Best Management Practices and good house-keeping procedures followed to mitigate impacts to the project site?									

SURFACE CLEARANCE & INTRUSIVE MEC INVESTIGATION OPERATIONS

1	MEC SOP	Verify hand held geophysical instruments are checked on test area (ITS).									
2	MEC SOP	Verify Dynamic Detection of Analog Geophysics (IVS) at the start and end of day for each operator and assigned instrument; Intrusive Team Leader logs as well as UXOQCS or designee, all items must be detected									
3	MEC SOP	Verify grids have been divided into individual search lanes									
4	QAPP/WP	Are Team Separation Distances maintained?									
5	MEC SOP 18-01-00	Are MEC team members swinging the analog detector back and forth to maintain the instrument tip within a few inches of the ground and complete coverage of the lane?									
6	GEO SOP	Verify DGM/AGM teams are perform and document a Static Repeatability check at the start and end of each day within 10% of the expected response									
7	QAPP/WP	Are all recovered materials properly inspected, further classified and segregated in accordance with the listed reference?									
8	ESS	Are anomalies investigated to the required depths?									
9	QAPP/WP	Are all subsurface anomalies removed from the hole prior to moving forward?									
10	QAPP/WP	MEC items properly identified, marked and their location recorded for future disposal?									
11	QAPP/WP	Verify the Team Leader is completing all entries on the Tablet or his portion of the Clearance Data and Munitions Accountability Log?									
12	MEC SOP	UXOQCS or designee checks 100% of mini-grids and/or confirms absence of items meeting failure criteria (width of 1.5" x length of 3") or larger in size was located within the Lot. No MEC or MPPEH with an EM-61 signal equivalent to, or greater than, the anomaly selection criteria (without an acceptable explanation) as determined in the IVS Report. UXOQCS or designee will verify saturated areas with non-Munition Debris ferrous metals.									
13	MEC SOP	Has each target location been searched to the extent of a 1-m radius of the anomaly and one of the following occurs; remnant mV response on a properly nulled EM61 is less than the target selection threshold, or the excavation has been identified and QC verified as saturated with non-MD ferrous metals. Lot size is equal to 500 anomalies.									
14	QAPP/WP	Verify embedded EM-61 operators properly performing 100% open hole verification IAW TPC, with a properly nulled EM61 to ensure the remaining millivolt (mV) response is below the target selection threshold? No subsurface finding of a signal equivalent to, or greater than, anomaly selection criteria without an acceptable explanation.									
15	QAPP/WP	Verify intrusive results reviewed by the Project Geophysicist to ensure they agree with geophysical response?									

16	QAPP/WP	Verify the project data being reviewed by the Project Geophysicist and UXOQCS for completeness and accuracy?									
ITEM	**REF**	**INSPECTION POINT**	PREPARATORY			INITIAL			FOLLOW UP		
			YES	NO	NA	YES	NO	NA	YES	NO	NA

EXPLOSIVE MANAGEMENT (MEC/MPPEH DEMOLITION OPERATIONS)

1	SOP	Is the Demolition Supervisor/UXO T3, verifying that proper positioning of donor explosives for the type of munition(s) being destroyed IAW USACE disposal guidelines?									
2	QAPP/WP	The UXOQCS or designee checks MEC Accountability Log for discrepancies weekly.									
3	QAPP/WP	The SUXOS verifies that all MEC and donor explosives placed in a disposal shot are consumed by the explosion and there are no kick-outs.									
4	QAPP/WP	UXOQCS verifies that 100% of all items on the MEC Accountability Log are accounted for and destroyed during demolition operations.									
5	EMP/ESP	Vehicle transporting explosives is inspected by operator prior to each demolition operation; documented and maintained onsite.									
6	QAPP/WP	Discrete soil samples will be collected directly beneath each MEC item that is safe to move and analyzed for all metals outlined in Worksheet #15b and #15c.									

MPPEH MANAGMENT OPERATIONS

1	ESS	Has all recovered MPPEH undergone a 100% inspection and an independent 100% re-inspection?									
2	ESS	Has all recovered MPPEH been properly classified as MDAS or MDEH?									
3	ESS	Has the Team Leader ensured no co-mingling of MDAS and MDEH?									
4	ESS	Has the SUXOS conducted random checks of munitions debris and range related debris to ensure there are no explosives hazards (energetic material) and correct materials category assignment? Munition Debris is identified by weight and type (target for DGM, grid for analog) as reported on the Project Site Daily Report.									
5	ESS	Is MDAS and/or MDEH been secured in sequentially numbered and labeled containers?									
6	ESS	Has MDAS and/or MDEH been processed for final disposition IAW referenced plans? Final disposition is accounted for using a DD Form 1348-1A when the material is certified safe, flashed and transferred to a qualified recycler.									

SOIL SAMPLE COLLECTION FOR MUNITION CONSTITUENTS (FIELD ACTIVITY)

1	MEC SOP 18-01-00	Are GPS points uploaded prior to startup and are hardcopy maps present during sample location demarcation?									
2	MEC SOP 18-01-00	Are sample locations demarcated in the field using a GPS unit to within ± 1 foot accuracy?									
3	MEC SOP 18-01-00	Verify each sample is located using GPS and marked with flagging or stakes									
4	MEC SOP 18-01-00	UXOQCS or designee checks 100% of sample locations									

DE-MOBILIZATION CHECKLIST

1	QAPP/WP	All temporary site features, equipment, rental property and debris have been identified at the project site.									
2	QAPP/WP	Verify company owned equipment and supplies have been accounted for.									
3	QAPP/WP	Verify leased equipment has been accounted for.									
4	QAPP/WP	Verify all pin flags, nails and grid stakes are removed; holes are backfilled and checked for leveling before each area is accepted by the government.									
5	QAPP/WP	Verify a joint (SUXOS, UXOQCS, PCD and USACE representatives) walk through has been scheduled.									

FINDINGS

ITEM	CATEGORY	COMMENTS

QC Signature:

NONCONFORMANCE LOG

SITE LOCATION		START DATE				
CONTRACT NO.		END DATE				
REPORT NUMBER	NONCONFORMANCE TITLE	ORIGIN	INITIATED	FINALIZED	ENG FORM 6048	COMMENTS

QUALITY CONTROL 3-PHASE INSPECTION LOG

SITE LOCATION		START DATE								
CONTRACT NO.		END DATE								
REPORT NUMBER	ACTIVITY INSPECTED	TEAM INSPECTED	Preparatory	Initial	Follow Up	PASS	FAIL	NCR	INITIALS	COMMENTS

QUALITY CONTROL SURVEILLANCES

SITE LOCATION		**START DATE**	
CONTRACT NO.		**END DATE**	

REPORT NUMBER	ACTIVITY INSPECTED	TEAM INSPECTED	COMMENTS	PASS	FAIL	NCR	INITIALS

QUALITY CONTROL INSPECTIONS

SITE LOCATION		START DATE	
CONTRACT NO.		END DATE	

REPORT NUMBER	ACTIVITY INSPECTED	TEAM(S) INSPECTED	COMMENTS	PASS TOTAL	PASS	FAIL	NCR	INITIALS

Seed Tracking Log

[Project Name]

[Location]

Contract #:__________________ Task Order #:____________________ Log Updated: ***[Date]***

Seed Type: Detection & Recovery	Grid / Transect ID	Seed ID #	Seed Description	Easting (ft) * approxiamate	Northing (ft) * approxiamate	UXO Team ID	Date of Seed Placement	Date of Discovery	QC Accepted	QA Accepted	MD lbs.	Non-MD lbs.	QA Seed #	Comments

Project Name / Installation = Enter the project name and installation where operations are being conducted.

Project Location = Enter the city or town and state location where operations are being conducted.

Contract # = Enter the contract number associated with the project.

Task Order # = Enter the project task order number.

Type of Seed Placed = A blind seed is buried with positional data recorded and an area coverage seed is placed on the surface with no positional data required. Just enter how many are place in each lot. (lot is determined at the project level.) Area detection seeds are only placed in analog geophyisical areas.

Grid/Transect ID = Enter the grid/transect location where the seed item was placed.

Seed Identification # = Enter the seed identification number. (All seeds should be numbered to ensure that all seed items are recovered at the end of the project.) No seed number is required for an area detection seed.

Seed Description = Briefly describe the item being used as a seed item.

Easting (ft) or X Coordinate = If a seed's location is being recorded using DGPS equipment or tape and line method, enter that coordinate here. (Not required for area detection seed.)

Northing (ft) or Y Coordinate = If a seed's location is being recorded using DGPS equipment or tape and line method, enter that coordinate here. (Not required for area detection seed.)

Depth (inches) = Enter how deep the item was placed from the top of the item to the surface in inches. (Not required for area detection seed.)

UXO Team ID = Enter the ID of the team that recovered the seed item.

Date of Seed Placement = Enter the date the seed was placed by Quality Control (QC) personnel in [MM/DD/YYYY] format.

Date of Discovery = Enter the date the team recovered the seed in [MM/DD/YYYY] format.

Field Change Request Tracking Log

SITE LOCATION:

CONTRACT NO:

FCR No	**Origination Date**	**Initiated By**	**FCR Description**	**Approved (A-) / Denied (D-) and Date (MM/DD/YYYY)**				
				TLI TM	**TLI SUXOS**	**USAESCH PM/COR**	**PCD**	**CDPHE**

DAILY QUALITY CONTROL REPORT

Project Name: Report No:

Project No: Location: Date:

☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday

Weather/Precipitation:	High Temperature: Low Temperature:	Wind:	Humidity

I. Personnel Present (Reference/attach Site Managers daily report, if applicable.)

Name	Position	Company

II. Work Performed (Annotate the field work performed during the Reporting Period.)

III. Quality Control Activities (Reference/attach inspection/surveillance reports.)

IV. Problems Encountered / Corrective Actions Taken

V. Directions Given / Received

VI. Special Notes / Lessons Learned

VII. Visitors

VIII. Certification (I certify that the above information is correct and complete.)

Name and Signature:	Title/Company:	Date:

PHOTOGRAPHIC DOCUMENTATION

DESCRIPTION:	
DESCRIPTION:	

Project Name:			Report No:
Project No:	Location:		Date:
Team/Function:		Activity Observed:	

I. Performance Requirement (List the specific performance requirement for Task/Activity observed, cite reference of requirements.)

II. Activities / Conditions Observed (Summarize observations in sufficient detail to document requirements have been met.)

III. Opportunities for Improvement/Lessons Learned

IV. Results of Surveillance Activities

☐ Acceptable ☐ Unacceptable NCR #:

Comments:

V. Certification (I certify that the above information is correct and complete.)

Name:	Signature:	Date:

VI. Distribution

☐ PM ☐ SITE MGR ☐ SSHO ☐ QUALITY MANAGER ☐ CLIENT REP

Project Name:		Task Order:	Report No:
Project No:	Location:		Date:
Team/Function:		Activity Inspected:	

I. Performance Requirement (List the specific performance requirement for Task/Activity inspected, cite reference of requirements.)

II. Inspection Summary (Summarize inspection in sufficient detail to document requirements have been met.)

III. Results of inspection

☐ Acceptable ☐ Unacceptable NCR #:

Comments:

IV. Certification (I certify that the above information is correct and complete.)

Name:	Signature:	Date:

V. Distribution

☐ PM ☐ SITE MGR ☐ SSHO ☐ QUALITY MANAGER ☐ CLIENT REP

NONCONFORMANCE AND CORRECTIVE ACTION REPORT (NCAR)

Project Name:		Report No:
Project No:	Location:	Date:
Source of Nonconformance:	Description of Process :	

I. Frequency of Nonconformance (previous deficiency for same process) ☐ Single Event ☐ Reoccurring Event

If a Reoccurrence list the previous Deficiency Report Numbers and dates (6048, DNR, NCR, CPATTS, CAR).

II. Description of Nonconformance *(Items involved; specification, code or standard to which the items do not conform) (Provide sketch if applicable)*

III. Severity of Nonconformance

☐ Low – Minor Nonconformance (No Perceived Risk to Safety, Quality, Cost and or Schedule, a deviation from procedures which are not likely to reduce TLI's ability to meet requirement and client specified level of quality.)

☐ Medium – Significant Nonconformance (Potential Risk to Safety, Quality, Cost and or Schedule, a deviation from planned requirements)

☐ High – Critical Nonconformance (Imminent Risk to Safety, Quality, Cost and or Schedule, a severe deviation from planned requirements)

IV. Immediate Actions Taken to Correct Condition

V. Root Cause Analysis (Cause(s) of problem) Utilize Problem Solving or Event Analysis Worksheets to develop RCA if necessary. Attach to document if used

VI. Corrective Action to Prevent Recurrence ☐ Required ☐ Not Required

VII. Verification of Corrective Action ☐ Required ☐ Not Required

Name & Signature of Person Verifying Disposition/CA:	Title/Company:	Date:

VIII. Approvals / Closeout Actions

☐ QCM	Name/Signature:	Date:	Approval:
Comments:			
☐ SUXOS	Name/Signature:	Date:	Approval:
Comments:			
☐ Team Leader	Name/Signature:	Date:	Approval:
Comments:			
☐ Site Manager	Name/Signature:	Date:	Approval:
Comments:			

Field Change Request (FCR)

Contract Task Order Name:	**CTO #:**	**Change Request No.:**
TO:	**Site:**	**Date:**

RE:

_____ Drawing # ___________________ Title: ______________________

______ Specific Sections:____________ Title: _________________________

______ Other: ______________________________

1. DESCRIPTION (items involved; submit sketch, if applicable):

2. REASON FOR CHANGE:

3. RECOMMENDED DISPOSITION (Submit example, if applicable):

_____Minor Change _____Major Change (Impacts Cost, Schedule)

4. DISPOSITION: (Approval Required by Client Representative)

__________Not Approved (give reason).

__________Considered minor change – APPROVED per recommended disposition – Documents will not be formally revised. Field office to maintain as–built records.

__________Considered major change – Client approval required via contract modification process.

Prepared by (Signature)	**Date:**
TLI Project/Task Manager	**Date:**
TLI SUXOS	**Date:**
CENWO Project Manager (Signature)	**Date:**

EQUIPMENT DEFICIENCY REPORT

Project Name:

Date: Click here to enter a date.

Team:

Work Process:

Instrument Type: White’s XLT

Instrument Serial Number :

I. Description of Fault (List the specific issue with the piece of equipment.)

Comments:

II. Quality Control Inspection of Fault / Recommendation (Verification of equipment issue.)

Comments:

III. Work Process Impacted by Equipment Issue? X☐ YES ☐NO ☐ N/A (Describe impacts to TLI Solutions work product and corrective measures taken as a result of the deficient equipment.)

Comments:

Name & Signature:	Title/Company:	Date:8/7/2017

INSTRUMENT TEST STRIP SCORE SHEET

Operator’s Full Name:	
Type of Instrument(s):	
Instrument Serial Number(s):	
Date:	

Item Description	Depth	Orientation
Small ISO **	4-Inches	Horizontal EW
Medium ISO	12-Inches	Vertical
Detection & Recovery	Surface	Horizontal
Small ISO	7-Inches	Vertical
Detection & Recovery	Surface	Horizontal
Small ISO	7-Inches	Vertical

** Denotes worst orientation

Seed Number	Function (X)	Technique (X)	Located (X)	Pass (Y/N)
1				
2				
3				
4				
5				
6				

Comments:

QCS/QCA Signature

Operator Signature:

Quality/Safety Weekly Progress Report

Client:	**Project Number:** Task Order:
Project:	**Location:**
Type of Project:	**Report No:**

I. Number of Personnel Assigned:

TLI Solutions	Subcontractor	Total Personnel

II. Quality/Safety Reports for Period Covered:

QA Corrective Action Requests / Deficiency Notices/ 6048's	Nonconformance Reports	CPATTS	QC Acceptance	QC Failures	QA Acceptance	QA Failures
0	0	0	0	0	0	0

Preparatory Phase Inspections	Initial Phase Inspections	Follow-On Phase Inspections	Surveillance Inspections	FCRs	EDR
0	0	0	0	0	0

Safety Inspections	Weekly Exposure Hours	Total Project Exposure Hours	Weekly Mileage	Total Project Mileage
0	0	0	0	0

Weekly Equipment Hours	Total Project Equipment Hours	Near Miss Reports	Accident Free Days	
0	0	0	0	

III. Describe Quality methods used and the specific pass/fail criteria for each process conducted during reporting period.

IV. Summarize Quality/Safety activities performed and describe any special conditions or circumstances encountered during this reporting period.

Client:	**Project Number:** Task Order:
Project:	**Location:**
Type of Project:	**Report No:**

V. Provide a list of all Quality/Safety failures or issues and describe corrective action taken.
VIII. List any opportunities for improvement identified during reporting period.
IX. Are contract/project requirements regarding quality and safety of services provided being met? Yes ☐ No☐
Comment if No:

Name and Signature	**Title/Company**	**Date**

EM-61 MK 2 DAILY CHECKLIST

Date	
Operator(s)	
Area/Project	
Unit (Coil Number or Color)	

Morning Checks:

Battery Number	
Starting Battery Level	
Check Cables/Connections (Y/N)	
5 Minute Warm-Up (Y/N)	
De-Metal Operator (Y/N)	
Null Instrument to 0 mv Background (Y/N)	
Cable Shake Test (move & shake cables) Was spiking induced by operator? (Y/N)	
1 Minute Static Test (stationary no item) Was spiking or noise observed? (Y/N)	
Standard Test Item Response (measure/expected in mv? (Y/N)	
Any failure/repair/replacement made at this time? (Y/N) If yes, explain.	

Afternoon Checks:

Battery Number	
Ending Battery Level	
Null Instrument to 0 mv Background (Y/N)	
1 Minute Static Test (stationary no item) Was spiking or noise observed? (Y/N)	
Standard Test Item Response (measure/expected in mv)	
Any malfunctions noted or needed for repairs (other than battery swap)? Explain.	
Operator's Printed Name & Signature	

APPENDIX G.3

SAFETY – FIELD FORMS

DAILY SAFETY BRIEFING

Date:	**Time:**
Location/Site:	

Weather

High:	Low:	Wind direction & MPH:	Describe:

Reason for briefing/training: (Check all that apply)

	Daily Safety Briefing/Training:
	Other (Explain):

Management	Signature	Position

UXO Team 1	Signature	Position

UXO Team 2	Signature	Position

COMPLETED DOCUMENT CONSTITUTES PROOF OF EMPLOYEE ATTENDANCE AND ACKNOWLEDGMENT

DAILY SAFETY BRIEFING

UXO Team 3	Signature	Position
Additional Personnel	**Signature**	**Position**
Oversight	**Signature**	**Position**

Topics Covered: (Check all that apply)	
	Radio Checks:
	Site Characterization:
	Biological Hazard(s):
	Safe Work Practices:
	Physical Hazard(s):
	Heat Stress/Cold Stress:
	Weather Hazard:
	Site Control:
	Field:
	Emergency Response:
	Hazard Communication SDS Binder:
	On-site Emergency:
	On-Site Injuries/Illnesses:
	Evacuation Procedures:
	Rally Point:
	Vehicle Safety:
	Heavy Equipment:

Conducted By:	Signature	Position
		UXO Safety Officer

COMPLETED DOCUMENT CONSTITUTES PROOF OF EMPLOYEE ATTENDANCE AND ACKNOWLEDGMENT

DAILY SAFETY INSPECTION AND WEEKLY AUDIT LOG
MEC OPERATIONS

DATE:	TIME:	LOG NUMBER:

CONTRACT NUMBER:	TASK ORDER NUMBER:

SITE NAME AND LOCATION:

WEATHER CONDITIONS:

HIGH:	LOW:	WINDS:	DESCRIPTION:

I. AREAS INSPECTED: (List by grid number, team or task)

II. INSPECTION RESULTS

Item Description	Pass	Item Description	Pass
Personal Protective Equipment (PPE)		Communication Equipment	
Safe Work Practices per SSHP/APP		Site Sanitation/Hand Wash	
Site Control per SSHP		Explosive Storage Magazine	
First Aid Kits/Eye Wash/Bloodborne		Motor Vehicle Serviceability/Operation	
Fire Extinguisher's		Smoking Area	
Flammable Storage Areas			
Safety & Health Monitoring Equipment			
SDS and Container Labeling per SSHP			

III. SUMMARY OF DEFICIENCIES NOTED: (If required)

IV. CORRECTIVE ACTIONS RECOMMENDED: (If required)

V. REINSPECTION RESULTS: (If required)

VI. SIGNATURES:

UXO Safety Officer:	I acknowledge that I have been briefed on the results of this Inspection and will take corrective action (if necessary) SUXOS/Site Supervisor:

Note: Safety inspections are to be conducted each day and documented on this form. This form will also be used to document Weekly Safety Audit conducted at the end of each workweek. The weekly audit will not only indicate the present status of the site/site operations, but will also be used to note the current status of deficiencies identified during daily inspections. Any daily inspection forms where deficiencies have been noted, and the weekly audit will be emailed to the Tech Law Occupational Safety and Health Manager.

SAFETY DEFICIENCY TRACKING LOG

Date Deficiency Identified:	Description of Deficiency:	Name of Person Correcting Deficiency:	Projected Resolution Date:	Date Deficiency Resolved:

OESS Signature:

Site Safety Signature:

VEHICLE INSPECTION CHECKLIST

Site Name/Location		**Site Supervisor**	
Operator/Inspector		**Team**	
License Plate Number		**Make/Model**	
Date Inspected		**Mileage**	

INSPECTING…	PASS	FAIL	COMMENTS:
DOCUMENTATION			
Registration/Insurance/Weather Plan			
Hospital Route/Site Phone Roster			
BRAKES			
Emergency Brake			
Service Brakes			
TIRES			
Pressure & Condition (To Include Spare Tire)			
FLUID LEVELS			
Engine Oil			
Engine Coolant			
Hydraulic Brake Fluid			
Power Steering Fluid			
Transmission Fluid			
Windshield Washer Fluid			
BELTS AND HOSES			
Belt Tension and Condition			
Hoses (Wear & Fluid Leaks)			
LIGHTS			
Headlights (High & Low)			
Brake Lights			
Parking Lights			
Reverse Lights & License Plate Lights			
Turn Signals			
Emergency Flashers			
GENERAL			
Windshield Wipers			
Windshield/Windows			
Mirrors			
Horn			
Seat Belts			
Steering			
Cleanliness			
EQUIPMENT			
First Aid Kit/Blood Borne Pathogen Kit			
Eyewash			
Tire Changing Equipment			
EXPLOSIVE CARRIER			* For explosive and fuel carriers only, inspect with each use
Fire Extinguishers & ~~No Smoking Signs~~			
Chocks, Placards & Tie Downs			
Exhaust System			

Inspector Signature

July 17, 2017
Revision: 01

UTV SAFETY AND MAINTENANCE CHECKLIST

Site Name/Location		**SUXOS**	
Operator/Inspector		**Team**	
Serial Number		**Make/Model**	
Date		**UTV Hours**	

INSPECTING…	WHAT YOU ARE LOOKING FOR?	PASS	FAIL	COMMENTS:
EXTERNAL				
Vehicle Body	Cracks, Damage			
Undercarriage	Wear, Damage, Leaks			
CV Boots	Tears, Damage, Grease Leaks			
Fuel Tank	Fuel Level, Damage, Leaks			
Fire Extinguisher	Charge, Damage			
Lights	Damage			
Tires	Air Pressure, Wear			
Hitches	Damage, Missing Hardware			
Winch & Cable	Proper Function, Wear, Damage **(If Present)**			
Windshield	Cracks **(If Present)**			
Windshield Wiper	Wear, Damage **(If Present)**			
Loose Objects in Cab or Bed	Properly Secured/Removed			
Overall Vehicle	Loose/Missing Nuts, Bolts, Guards, Cleanliness			
ENGINE COMPARTMENT				
Engine Oil	Fluid Level			
Engine Coolant	Fluid Level			
Hydraulic Brake Fluid	Fluid Level			
Radiator	Fin Blockage, Leaks			
All Hoses	Cracks, Wear Spots, Leaks			
All Belts	Tightness, Wear, Cracks			
Overall Engine Compartment	Trash or Dirt Buildup, Leaks			
INSIDE THE CAB				
Seat	Adjustment			
Seatbelts & Mounting	Damage, Wear, Adjustment			
Batteries & Hold Downs	Cleanliness, Loose Bolts & Nuts			
Horn	Proper Function			
Rear View Mirror	Damage, Secured			
Indicators, Turn Signals	Proper Function			
Monitor Panel	Proper Function			
Switches	Proper Function			
Parking Brake	Proper Function			
Main Brake	Proper Function			
Rollover Protection System	Damage, Loose Mounting Bolts			

Inspectors Signature

Site Name/Location		**SUXOS**	
Operator/Inspector		**Team**	
Serial Number		**Make/Model**	
Date		**Machine Hours**	

INSPECTING	WHAT YOU ARE LOOKING FOR?	PASS	FAIL	COMMENTS
FROM THE GROUND				
Mower Deck	Excessive Wear or Damage, Cracks			
Bucket Cylinder/Linkage	Excessive Wear, Damage, Leaks, Lubricate			
Stick, Cylinder	Wear, Damage, Leaks, Lubricate			
Boom, Cylinders	Wear, Damage, Leaks, Lubricate			
Underneath Machine	Final Drive Leaks, Swing Drive Leaks, Damage			
Car body	Cracks, Damage			
Undercarriage	Wear, Damage, Tension			
Steps & Handholds	Condition and Cleanliness			
Batteries & Hold Downs	Cleanliness, Loose Bolts & Nuts			
Fire Extinguisher	Charge, Damage			
Engine Coolant	Fluid Level			
Primary/Secondary Fuel Filters	Leaks, Drain Water Separator			
Air Filter	Restriction Indicator			
Hydraulic Oil Tank	Fluid Level, Damage, Leaks			
Hydraulic Oil Filter	Leaks			
Radiator	Fin Blockage, Leaks			
Hydraulic Oil Cooler	Fin Blockage, Leaks			
AC Condenser	Fin Blockage, Leaks			
Lights and Mirrors	Damage			
Engine Oil Filter	Leaks			
Tires and Rims	Leaks, cuts, lug nuts loose or missing			
Overall Machine	Loose/Missing Nuts, Bolts, Guards, Cleanliness			
ENGINE COMPARTMENT				
Engine Oil	Fluid Level			
Swing Gear Oil	Fluid Level, Leaks			
Swing Drive Pinion Grease	Water			
Fuel Tank	Fuel Level, Damage, Leaks			
All Hoses	Cracks, Wear Spots, Leaks			
All Belts	Tightness, Wear, Cracks			
Overall Engine Compartment	Trash or Dirt Buildup, Leaks			
INSIDE THE CAB				
Seat	Adjustment			
Seatbelt & Mounting	Damage, Wear, Adjustment			
Horn, Travel Alarm, Lights	Proper Function			
Indicators	Proper Function			
Monitor Panel	Proper Function			
Switches	Proper Function			
Travel Controls	Correct Operation			
Heating & Cooling System	Proper Function			
ROPS	Damage, Loose Mounting Bolts			

Inspectors Signature

HYDRAULIC EXCAVATOR SAFETY & MAINTENANCE CHECKLIST

Site Name/Location		**SUXOS**	
Operator/Inspector		**Team**	
Serial Number		**Make/Model**	
Date		**Machine Hours**	

INSPECTING	WHAT YOU ARE LOOKING FOR?	PASS	FAIL	COMMENTS
FROM THE GROUND				
Bucket	Excessive Wear or Damage, Cracks			
Bucket Cylinder/Linkage	Excessive Wear, Damage, Leaks, Lubricate			
Stick, Cylinder	Wear, Damage, Leaks, Lubricate			
Boom, Cylinders	Wear, Damage, Leaks, Lubricate			
Underneath Machine	Final Drive Leaks, Swing Drive Leaks, Damage			
Car body	Cracks, Damage			
Undercarriage	Wear, Damage, Tension			
Steps & Handholds	Condition and Cleanliness			
Batteries & Hold Downs	Cleanliness, Loose Bolts & Nuts			
Fire Extinguisher	Charge, Damage			
Engine Coolant	Fluid Level			
Primary/Secondary Fuel Filters	Leaks, Drain Water Separator			
Air Filter	Restriction Indicator			
Hydraulic Oil Tank	Fluid Level, Damage, Leaks			
Hydraulic Oil Filter	Leaks			
Radiator	Fin Blockage, Leaks			
Hydraulic Oil Cooler	Fin Blockage, Leaks			
AC Condenser	Fin Blockage, Leaks			
Lights and Mirrors	Damage			
Engine Oil Filter	Leaks			
Overall Machine	Loose/Missing Nuts, Bolts, Guards, Cleanliness			
ENGINE COMPARTMENT				
Engine Oil	Fluid Level			
Swing Gear Oil	Fluid Level, Leaks			
Swing Drive Pinion Grease	Water			
Fuel Tank	Fuel Level, Damage, Leaks			
All Hoses	Cracks, Wear Spots, Leaks			
All Belts	Tightness, Wear, Cracks			
Overall Engine Compartment	Trash or Dirt Buildup, Leaks			
INSIDE THE CAB				
Seat	Adjustment			
Seatbelt & Mounting	Damage, Wear, Adjustment			
Horn, Travel Alarm, Lights	Proper Function			
Indicators	Proper Function			
Monitor Panel	Proper Function			
Switches	Proper Function			
Travel Controls	Correct Operation			
Heating & Cooling System	Proper Function			
ROPS	Damage, Loose Mounting Bolts			

Inspector Signature

SITE:	CONTRACT NUMBER:	TASK ORDER NUMBER:

DATE:	TIME:	PRINTED NAME & SIGNATURE:	ORGANIZATION/COMPANY:	PURPOSE OF VISIT:

DEMOLITION SUPERVISOR PRE-DEMOLITION/DISPOSAL BRIEFING FOR MEC OPERATIONS

Project Name:		**Project Number:**	
Location:		**Date:**	
Type and quantity of MEC being disposed of:			
Type and quantity of donor material being used:			
Demolition equipment being used (i.e. galvanometer, remote firing device, blasting machine, firing wire, etc.):			
Method of initiation:			
☐ RFD	☐ ELECTRIC	☐ NON-EL w/w-o RFD	☐ NON-ELECTRIC
Radio & cellular communication established:		**Explosives vehicle inspected and inventoried**	
☐ YES	☐ NO	☐ YES	☐ NO
Motor Vehicle Inspection (Transporting Hazardous Material) DD Form 626 Required:			
☐ YES	☐ NO		

Route to disposal site:		
Misfire procedures briefed IAW TLI Solutions MEC SOP 18-04-02 Demolition/Disposal Operations of Munitions.		
☐ Notifications made ☐ Safety notified base operations 30-minutes prior to detonation		
☐ Exclusion Zone established ☐ Disposal site secure ☐ Road Guards in position		
☐ Request permission to final prime ☐ Reconfirm site is secure ☐ Fire in the hole		
☐ Request 5-minute wait time ☐ Demo Supervisor verifies disposal ☐ Range maintenance		
Special notes: (include lessons learned, positive observations, areas requiring improvement)		
Certification (I certify that the above information is correct and complete.)		
Name and Title: Demo Supervisor	Signature:	Date:
Verification (I verify that the above information is correct and complete.)		
Name and Title: Demo Safety Officer	Signature:	Date:

MOTOR VEHICLE INSPECTION (TRANSPORTING HAZARDOUS MATERIALS)

(Read Instructions before completing this form.)

This form applies to all vehicles which must be marked or placarded in accordance with Title 49 CFR.	**1. BILL OF LADING/TRANSPORTATION CONTROL NUMBER**

SECTION 1 - DOCUMENTATION	**ORIGIN** **a.**	**DESTINATION** **b.**
2. CARRIER/GOVERNMENT ORGANIZATION		
3. DATE/TIME OF INSPECTION		
4. LOCATION OF INSPECTION		
5. OPERATOR(S) NAME(S)		
6. OPERATOR(S) LICENSE NUMBER(S)		
7. MEDICAL EXAMINER'S CERTIFICATE*		

8. *(X if satisfactory at origin)*			
a. HAZMAT ENDORSEMENT		**d. ERG OR EQUIVALENT COMMERCIAL:** ☐ YES ☐ NO	
b. VALID LEASE*		**e. DRIVER'S VEHICLE INSPECTION REPORT***	
c. ROUTE PLAN		**f. COPY OF 49 CFR PART 397**	

9. CVSA DECAL DISPLAYED ON COMMERCIAL EQUIPMENT*	**YES**	**NO**
a. TRUCK/TRACTOR		
b. TRAILER		

SECTION II - MECHANICAL INSPECTION

All items shall be checked on empty equipment prior to loading. Items with an asterisk shall be checked on all incoming loaded equipment.

10. TYPE OF VEHICLE(S)	**11. VEHICLE NUMBER(S)**

12. PART INSPECTED *(X as applicable)*	**ORIGIN (1)**		**DESTINATION (2)**			**ORIGIN (1)**		**DESTINATION (2)**		**COMMENTS (3)**
	SAT	UNSAT	SAT	UNSAT		SAT	UNSAT	SAT	UNSAT	
a. SPARE ELECTRICAL FUSES					**k. EXHAUST SYSTEM**					
b. HORN OPERATIVE					**l. BRAKE SYSTEM***					
c. STEERING SYSTEM					**m. SUSPENSION**					
d. WINDSHIELD/WIPERS					**n. COUPLING DEVICES**					
e. MIRRORS					**o. CARGO SPACE**					
f. WARNING EQUIPMENT					**p. LANDING GEAR***					
g. FIRE EXTINGUISHER*					**q. TIRES, WHEELS, RIMS**					
h. ELECTRICAL WIRING					**r. TAILGATE/DOORS***					
i. LIGHTS AND REFLECTORS					**s. TARPAULIN***					
j. FUEL SYSTEM*					**t. OTHER** *(Specify)*					

13. INSPECTION RESULTS *(X one)* **ACCEPTED** ☐ **REJECTED** ☐

(If rejected give reason under "Remarks". Equipment will be approved if deficiencies are corrected prior to loading.)

14. SATELLITE MOTOR SURVEILLANCE SYSTEM: *(X one)* **ACCEPTED** ☐ **REJECTED** ☐

15. REMARKS

16. INSPECTOR SIGNATURE *(Origin)*	**17. INSPECTOR SIGNATURE** *(Destination)*

SECTION III - POST LOADING INSPECTION

This section applies to Commercial and Government/Military vehicles. All items will be checked prior to release of loaded equipment and shall be checked on all incoming loaded equipment.

	ORIGIN (1)		**DESTINATION (2)**		**COMMENTS (3)**
	SAT	UNSAT	SAT	UNSAT	
18. LOADED IAW APPLICABLE SEGREGATION/COMPATIBILITY TABLE OF 49 CFR					
19. LOAD PROPERLY SECURED TO PREVENT MOVEMENT					
20. SEALS APPLIED TO CLOSED VEHICLE; TARPAULIN APPLIED ON OPEN EQUIPMENT					
21. PROPER PLACARDS APPLIED					
22. SHIPPING PAPERS/DD FORM 2890 FOR GOVERNMENT VEHICLE SHIPMENTS					
23. COPY OF DD FORM 626 FOR DRIVER					
24. SHIPPED UNDER DOT SPECIAL PERMIT 868					

25. INSPECTOR SIGNATURE *(Origin)*	**26. DRIVER(S) SIGNATURE** *(Origin)*
27. INSPECTOR SIGNATURE *(Destination)*	**28. DRIVER(S) SIGNATURE** *(Destination)*

INSTRUCTIONS

SECTION I - DOCUMENTATION

General Instructions.

All items (2 through 9) will be checked at origin prior to loading. Items with an asterisk (*) apply to commercial operators or equipment only. Only Items 2 through 7 are required to be checked at destination.

Items 1 through 5. Self explanatory.

Item 6. Enter operator's Commercial Driver's License (CDL) number or Military OF-346 License Number. CDL and OF-346 must have the HAZMAT and other appropriate endorsements IAW 49 CFR 383.

Item 7. *Enter the expiration date listed on the Medical Examiner's Certificate.

Item 8.a. Hazardous Materials Certification. In accordance with applicable service regulations, ensure operator has been certified to transport hazardous materials. Check the expiration date on driver's HAZMAT Certification.

b. *Valid Lease. Shipper will ensure a copy of the appropriate contract or lease is carried in all leased vehicles and is available for inspection. (49 CFR 376.12 and 376.11(c)(2)).

c. Route Plan. Prior to loading any Hazard Class/Division 1.1, 1.2, or 1.3 (Explosives) for shipment, ensure that the operator possesses a written route plan in accordance with 49 CFR Part 397. Route Plan requirements for Hazard Class 7 (Radioactive) materials are found in 49 CFR 397.101.

d. Emergency Response Guidebook (ERG) or Equivalent. Commercial operators must be in possession of an ERG or equivalent document. Shipper will provide applicable ERG page(s) to military operators.

e. *Driver's Vehicle Inspection Report. Review the operator's Vehicle Inspection Report. Ensure that there are no defects listed on the report that would affect the safe operation of the vehicle.

f. Copy of 49 CFR Part 397. Operators are required by regulation to have in their possession a copy of 49 CFR Part 397 (Transportation of Hazardous Materials Driving and Parking Rules). If military operators do not possess this document, shipper will provide a copy to operator.

Item 9. *Commercial Vehicle Safety Alliance (CVSA) Decal. Check to see if equipment has a current CVSA decal and mark applicable box. Vehicles without CVSA, check documentation of the last vehicle periodic inspection and perform DD Form 626 inspection.

SECTION II - MECHANICAL INSPECTION

General Instructions.

All items (12.a. through 12.t.) will be checked on all incoming empty equipment prior to loading. All UNSATISFACTORY conditions must be corrected prior to loading. Items with an asterisk (*) shall be checked on all incoming loaded equipment. Unsatisfactory conditions that would affect the safe off-loading of the equipment must be corrected prior to unloading.

SECTION II *(Continued)*

Item 12.a. Spare Electrical Fuses. Check to ensure that at least one spare fuse for each type of installed fuse is carried on the vehicle as a spare or vehicle is equipped with an overload protection device (circuit breaker). (49 CFR 393.95)

b. Horn Operative. Ensure that horn is securely mounted and of sufficient volume to serve purpose. (49 CFR 393.81)

c. Steering System. The steering wheel shall be secure and must not have any spokes cracked through or missing. The steering column must be securely fastened. Universal joints shall not be worn, faulty or repaired by welding. The steering gear box shall not have loose or missing mounting bolts or cracks in the gear box mounting brackets. The pitman arm on the steering gear output shaft shall not be loose. Steering wheel shall turn freely through the limit of travel in both directions. All components of a power steering system must be in operating condition. No parts shall be loose or broken. Belts shall not be frayed, cracked or slipping. The power steering system shall not be leaking. (49 CFR 396 Appendix G)

d. Windshield/Wipers. Inspect to ensure that windshield is free from breaks, cracks or defects that would make operation of the vehicle unsafe; that the view of the driver is not obscured and that the windshield wipers are operational and wiper blades are in serviceable condition. Defroster must be operative when conditions require. (49 CFR 393.60, 393.78 and 393.79)

e. Mirrors. Every vehicle must be equipped with two rear vision mirrors located so as to reflect to the driver a view of the highway to the rear along both sides of the vehicle. Mirrors shall not be cracked or dirty. (49 CFR 393.80)

f. Warning Equipment. Equipment must include three bidirectional emergency reflective triangles that conform to the requirements of FMVSS No. 125. FLAME PRODUCING DEVICES ARE PROHIBITED. (49 CFR 393.95)

g. Fire Extinguisher. Military vehicles must be equipped with one serviceable fire extinguisher with an Underwriters Laboratories rating of 10 BC or more. (Commercial motor vehicles must be equipped with one serviceable 10 BC Fire Extinguisher). Fire extinguisher must be located so that it is readily accessible for use and securely mounted on the vehicle. The fire extinguisher must be designed, constructed and maintained to permit visual determination of whether it is fully charged. (49 CFR 393.95)

h. Electrical Wiring: Electrical wiring must be clean and properly secured. Insulation must not be frayed, cracked or otherwise in poor condition. There shall be no uninsulated wires, improper splices or connections. Wires and electrical fixtures inside the cargo area must be protected from the lading. (49 CFR 393.28)

INSTRUCTIONS

SECTION II *(Continued)*

i. Lights/Reflectors. (Head, tail, turn signal, brake, clearance, marker and identification lights, Emergency Flashers). Inspect to see that all lighting devices and reflectors required are operable, of proper color and properly mounted. Ensure that lights and reflectors are not obscured by dirt or grease or have broken lenses. High/Low beam switch must be operative. Emergency Flashers must be operative on both the front and rear of vehicle. (49 CFR 393.24, 25, and 26)

j. Fuel System. Inspect fuel tank and lines to ensure that they are in serviceable condition, free from leaks, or evidence of leakage and securely mounted. Ensure that fuel tank filler cap is not missing. Examine cap for defective gasket or plugged vent. Inspect filler necks to see that they are in completely serviceable condition and not leaking at joints. (49 CFR 393.83)

k. Exhaust System. Exhaust system shall discharge to the atmosphere at a location to the rear of the cab or if the exhaust projects above the cab, at a location near the rear of the cab. Exhaust system shall not be leaking at a point forward of or directly below the driver compartment. No part of the exhaust system shall be located where it will burn, char or damage electrical wiring, fuel system or any other part of the vehicle. No part of the exhaust system shall be temporarily repaired with wrap or patches. (49 CFR 393.83)

l. Brake System (to include hand brakes, parking brakes and Low Air Warning devices). Check to ensure that brakes are operational and properly adjusted. Check for audible air leaks around air brake components and air lines. Check for fluid leaks, cracked or damaged lines in hydraulic brake systems. Ensure that parking brake is operational and properly adjusted. Low Air Warning devices must be operative. (49 CFR 393.40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 51, 52, 53, and 55)

m. Suspension. Inspect for indications of misaligned, shifted or cracked springs, loosened shackles, missing bolts, spring hangers unsecured at frame and cracked or loose U-bolts. Inspect for any unsecured axle positioning parts, and sign of axle misalignment, broken torsion bar springs (if so equipped). (49 CFR 393.207)

n. Coupling Devices (Inspect without uncoupling). Fifth Wheels: Inspect for unsecured mounting to frame or any missing or damaged parts. Inspect for any visible space between upper and lower fifth wheel plates. Ensure that the locking jaws are around the shank and not the head of the kingpin. Ensure that the release lever is seated properly and safety latch is engaged. Pintle Hook, Drawbar, Towbar Eye and Tongue and Safety Devices: Inspect for unsecured mounting, cracks, missing or ineffective fasteners (welded repairs to pintle hook is prohibited). Ensure safety devices (chains, hooks, cables) are in serviceable condition and properly attached. (49 CFR 393.70 and 71)

o. Cargo Space. Inspect to ensure that cargo space is clean and free from exposed bolts, nuts, screws, nails or inwardly projecting parts that could damage the lading. Check floor to ensure it is tight and free from holes. Floor shall not be permeated with oil or other substances. (49 CFR 393.84)

p. Landing Gear. Inspect to ensure that landing gear and assembly are in serviceable condition, correctly assembled, adequately lubricated and properly mounted.

SECTION II *(Continued)*

q. Tires, Wheels and Rims: Inspect to ensure that tires are properly inflated. Flat or leaking tires are unacceptable. Inspect tires for cuts, bruises, breaks and blisters. Tires with cuts that extend into the cord body are unacceptable. Thread depth shall not be less than: 4/32 inches for tires on a steering axle of a power unit, and 2/32 inches for all other tires. Mixing bias and radial on the steering axle is prohibited. Inspect wheels and rims for cracks, unseated locking rings, broken, loose, damaged or missing lug nuts or elongated stud holes. (49 CFR 393.75)

r. Tailgate/Doors. Inspect to see that all hinges are tight in body. Check for broken latches and safety chains. Doors must close securely. (49 CFR 177.835(h))

s. Tarpaulin. If shipment is made on open equipment, ensure that lading is properly covered with fire and water resistant tarpaulin. (49 CFR 177.835(h))

t. Other Unsatisfactory Condition. Note any other condition which would prohibit the vehicle from being loaded with hazardous materials.

Item 14. For AA&E and other shipments requiring satellite surveillance, ensure that the Satellite Motor Surveillance System is operable. The DTTS Message Display Unit, when operative, will display the signal "DTTS ON". The munitions carrier driver, when practical, will position the DTTS message display unit in a manner that allows the shipping inspector or other designated shipping personnel to observe the "DTTS ON" message without climbing aboard the cab of the motor vehicle.

SECTION III - POST LOADING INSPECTION

General Instructions.

All placarded quantities items will be checked prior to the release of loaded equipment. Shipment will not be released until deficiencies are corrected. All items will be checked on incoming loaded equipment. Deficiencies will be reported in accordance with applicable service regulations.

Item 18. Check to ensure shipment is loaded in accordance with 49 CFR Part 177.848 and the applicable Segregation or Compatibility Table of 49 CFR 177.848.

Item 19. Check to ensure the load is secured from movement in accordance with applicable service outload drawings.

Item 20. Check to ensure seal(s) have been applied to closed equipment; fire and water resistant tarpaulin applied on open equipment.

Item 21. Check to ensure each transport vehicle has been properly placarded in accordance with 49 CFR 172.504.

Item 22. Check to ensure operator has been provided shipping papers that comply with 49 CFR 172.201 and 202. For shipments transported by Government vehicle, shipping paper will be DD Form 2890.

Item 23. Ensure operator(s) sign DD Form 626, are given a copy and understand the hazards associated with the shipment.

Item 24. Applies to Commercial Shipments Only. If shipment is made under DOT Special Permit 868, ensure that shipping papers are properly annotated and copy of Special Permit 868 is with shipping papers.

Item 26. Ensure driver/operator signs DD Form 626 at origin.

Item 28. Ensure driver/operator signs DD Form 626 at destination.

HAND TOOL INSPECTION REGISTER

SITE LOCATION

CONTRACT NO.

CODE	DEVIATIONS
A1	Damaged/Broken Handle
A2	Damaged Casting
A3	Damaged Guard
A4	Loose fittings, screw, bolts
A5	Corroded

NOTE: Annotate the code in the appropriate block. "Defective" hand tools must be reported to the site safety officer and removed from service. If the tool cannot be properly repaired it must be destroyed and discarded. Each hand tool must be inspected separately to ensure it is documented and in a safe condition.

TEAM	ITEMS INSPECTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	INSPECTORS INITIALS:																															
TEAM	ITEMS INSPECTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	INSPECTORS INITIALS:																															
TEAM	ITEMS INSPECTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	INSPECTORS INITIALS:																															
TEAM	ITEMS INSPECTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	INSPECTORS INITIALS:																															

APPENDIX H

BLIND SEED FIREWALL PLAN

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BLIND SEED FIREWALL PLAN

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2

TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers,
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F18D0001, Task Order No. W912BV20F0207

Blind Seed Firewall Plan

1.0 Introduction

This Blind Seed Firewall Plan has been developed to describe general procedures for maintaining the confidentiality for the locations of blind quality control (QC) seeds placed within full coverage grids for the terrestrial EM61 detection survey. Only specific project personnel are required to have knowledge and access to the QC seed information to ensure the integrity of the data collection, processing and analysis. After the Quality Assurance Project Plan (QAPP) is finalized and before mobilization, the AECOM Geophysics QC Manager, and the U.S. Army Corps of Engineer (USACE) Technical Representative will agree on the number, type, and spatial distribution of QC seeds.

2.0 Quality Control Personnel

AECOM personnel involved in data collection, processing and intrusive removal activities on the project will be prevented from having access to information related to the detailed information for the QC seeds. The information will be provided to them only as needed for post-processing analyses, such as a root-cause analysis (RCA), and only after documented permission to share the information has been received from the USACE Technical Representative and / or Project Manager. The following personnel are the only members of the project team who will have access to the detailed QC seed information:

- AECOM QC Geophysicist
- MMG-TLI JV Unexploded Ordnance Quality Control Specialist
- AECOM / MMG-TLI JV Seed Team Lead
- USACE Technical Representative

3.0 Information Transfer/Storage

The QC seed information will be recorded by the AECOM Seed Team Lead upon placement of the seeds in the field. Unless permission is received from the USACE Technical Representative to share with other members of the project team, information may only be transferred between the individuals identified above. Transfer of QC blind seed data may occur as email attachments or directly to a protected network drive. The information and data will be stored only in: 1. Password protected files on local hard drives of the PCs assigned to the individuals listed above; 2. Protected folders on the AECOM file server accessible only to the staff listed above and the server administrator. The QC seed information will be transferred to the USACE Technical Representative on a weekly basis during the blind seed program in digital format (e.g., MS Excel or MS Access).

Seeding positioning equipment will be separate from equipment used by the field teams. If the need arises and the seeding team and field survey teams share equipment, the seeding operations data will be deleted from the survey/GPS equipment each day.

QC data will be released to the data analyst on a Delivery Unit basis after successfully locating and targeting all QC seeds located within the subject Delivery Unit.

4.0 Commitment to Confidentiality

The personnel identified in this document, or others added with the USACE Technical Representative and/or PM’s permission, will be required to provide a letter of confidentiality (either email or hard copy) to comply with the requirements established in this document (Attachment 1). The letters of confidentiality will be kept on record by the AECOM Quality Control Manager and MMG-TLI JV PM and added to the project files.

LHAAP-17 MEC Identification and Removal in Support of Remedy in Place

Longhorn Army Ammunition Plant, Texas

Letter of Confidentiality

"I will abide by the requirements of the Blind Seed Firewall Plan and not distribute any information related to the blind QC seeds to any other project personnel except those specified in the Blind Seed Firewall Plan"

My signature below indicates my agreement to maintain strict confidentiality of all information gained or exposed to during the course of fulfilling my job duties and responsibilities.

Print Name: ____

Signature: ____

Date: ____

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APPENDIX I

TABLE OF DEVIATIONS

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Table of Changes to Recommended Text in MR-QAPP Template

Section	Original text
Table 22-1 MQO "Construct IVS: Verify as-built IVS against design plan (Analog sensors)"	Responsible Person/Reporting Method/Verified by: "Project Geophysicist/ IVS Technical Memorandum/ Lead Organization"
Table 22-2 MQO "Ongoing instrument function test (DGM)"	Beginning and end of each day and each time instrument is turned on
Table 22-3 MQO "Detection survey performance (Digital)"	All blind QC seeds must be detected and positioned within 40cm radius of ground truth

New Text	**Explanation**
Responsible Person/Reporting Method/Verified by: "UXOQC"	ITS is different from IVS. UXO Team Lead is responsible for analog functionality. IVS Report will not document ITS results.
Beginning and end of each day	Static tests in addition to the twice daily tests are redundant and unnecessary.
90% of blind QC seeds must be detected and positioned within 65 cm and 100% within 75cm of ground truth	For an EM61 survey with 0.8 m spacing, 40 cm QC positioning is not appropriate. Other project work and consulting with USACE Geophysicists indicate 2015 EM-200-1-15 guidance for the EM61 is more appropriate – 90% positioning offset is <=25 cm + ½ line/sensor spacing and 100% is <=35cm + ½ line/sensor for digital positioning systems (<=50cm + 1/2 line spacing for fiducially positioned data).

APPENDIX J

GROUNDWATER EXTRACTION SYSTEM DESIGN ELEMENTS

GROUNDWATER EXTRACTION SYSTEM DESIGN ELEMENTS

LHAAP-17 BURNING GROUND NO.2/FLASHING AREA GROUP 2
TIME CRITICAL REMOVAL ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND MUNITIONS CONSTITUENTS (MC)

LONGHORN ARMY AMMUNITION PLANT, TEXAS

Prepared for

United States Army Corps of Engineers,
Tulsa District
2488 E 81st Street, Suite 1600
Tulsa, OK 74137

Contract No. W9128F-18-D-0001, Task Order No. W912BV20F0207

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ATTACHMENTS

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List of Acronyms and Abbreviations

EPA	United States Environmental Protection Agency
ft	feet
gpm	gallons per minute
IWWP	Installation Wide Work Plan
LHAAP	Longhorn Army Ammunition Plant
MEC	Munitions and Explosives of Concern
MMG	Munitions Management Group, LLC
MMG-TLI JV	Munitions Management Group, LLC-TLI Solutions Joint Venture
MMRP	Military Munitions Response Program
RD/RAWP	Remedial Design/ Remedial Action Work Plan
TCE	Trichlorethene
TCEQ	Texas Commission on Environmental Quality
TCRA	Time Critical Removal Action
TLI	TLI Solutions
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
VOC	volatile organic compound

1. INTRODUCTION

The enclosed provides the design elements of the groundwater extraction treatment system to be installed during the TCRA at LHAAP-17 Burning Ground No.2/Flashing Area Group 2 (hereinafter LHAAP-17), Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. Installation of the groundwater extraction system is being performed under the TCRA described in the UFP-QAPP. Groundwater extraction, performance evaluation, baseline sampling and performance monitoring is being performed and documented in accordance with and under the approved *Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas (Bhate Environmental Associates, Inc. [Bhate] 2019)*.

The following is provided as supporting documentation for implementation of the installation of the groundwater extraction system per the TCRA. The following text are excerpts directly from the approved RD/RAWP. **Attachment 1** provides supporting tables, figures and appendices from the RD/RAWP related to the installation of the groundwater extraction system.

2. AQUIFER PUMPING TEST

An aquifer-pumping test was conducted at LHAAP-17 beginning on January 19, 2018 and concluding on January 27, 2018. The aquifer-pumping test was performed following the PDI Work Plan (AECOM 2016) and consisted of 1) installation of three new piezometers; 2) period of ambient monitoring; 3) step-drawdown test; 4) constant-rate test; and 5) recovery test. The aquifer-pumping test was conducted to evaluate aquifer and pumping well properties that will provide a basis for the design (capture area, design pumping rates, piping requirements, etc.) of the groundwater recovery system specified as part the selected remedy in the ROD (Shaw 2016). Monitoring Well 17WW02 was used as the primary pumping well, and wells 17WW01 and 17WW06 were used as supplemental pumping locations at the end of the constant-rate pumping test.

The test was performed to obtain additional data for the RD as described in the PDI Work Plan (AECOM 2016). Previously, a 4-hour pumping test was conducted in 17WW01, 17WW02, and 17WW06 and indicated that the potentially sustainable pumping rates ranged from 0.89 to 1.49 gallons per minute (gpm) (AECOM 2016). The initial step test performed in January 2018 indicated that these rates could not be sustained from 17WW02. The rates in the constant-rate test ranged from 0.25 gpm in 17WW02 to 1.5 gpm in 17WW01 and 17WW06 when they were pumping. The aquifer recovered in less than 24 hours as expected. A detailed description of aquifer testing and conclusions is included in Draft Final PDI (APTIM 2018).

The Transmissivity (T), Hydraulic Conductivity (K), and Storativity (S) values calculated from the recovery tests were very consistent between all three piezometers, and generally within an order of magnitude of the values calculated from the constant-rate test data. The relatively good agreement between the two sets of calculated values provides confidence that the values are representative of the area in the vicinity of 17WW02 and may be extrapolated for use elsewhere at LHAAP-17 based on the pumping data collected from 17WW01 and 17WW06. The values calculated based on the recovery data are more consistent and should provide a good basis for designing the pumping system needed to capture and remove the high concentrations of perchlorate present in groundwater in the vicinity of 17WW06 in accordance with the selected remedy in the ROD. Because the late term pumping data from 17WW06 indicate that it may be capable of producing greater than 1.5 gpm, careful consideration has been given to the design of the pumping system described in **Section 3.0**.

3. GROUNDWATER EXTRACTION DESIGN

The groundwater extraction system will include groundwater recovery pumps installed in two extraction wells located within the perchlorate and TCE groundwater plumes (17WW02 and 17WW06). Baseline groundwater samples will be collected from 17WW01, 17WW02, and 17WW06 prior to beginning the system construction. The sample from 17WW01 will be collected with a pump inlet depth of 28 feet and 17WW02 will be collected with a pump inlet depth of 20 feet to be consistent with the 2009 and 2010 samples collected from those locations, which contained perchlorate concentrations exceeding 20,000 µg/L. As discussed in Section 1.5, the sample collection at 17WW01 and 17WW02 will be a deviation from the IWWP. The remaining groundwater samples will be collected in accordance with the IWWP (Bhate 2018b). If the perchlorate concentration in well 17WW01 is greater than 20,000 µg/L, 17WW01 will be outfitted with a pump and used as an extraction well along with 17WW02 and 17WW06. The extracted groundwater will be piped to the existing 4-inch conveyance line from LHAAP-16 to the groundwater treatment plant (GWTP) for treatment, prior to discharge to Harrison Bayou. The design in this document focuses on extracting and conveying the groundwater to the existing line and not on the treatment at the GWTP. The GWTP process is designed to treat groundwater impacted with perchlorate and volatile organic compounds and has the capacity to treat the contaminants from LHAAP-17.

4. SYSTEM COMPONENTS

The pumps in the extraction wells will be pneumatically operated using compressed air supplied by a compressor to be installed at the site. The decision to use pneumatic pumps was driven by the range of flow rates potentially expected in the two wells, the distance of the site from electrical power lines, and the ability to easily avoid damage to the pumps, which could occur if electric submersible pumps were used and ran dry.

Figure 5-2 of the RD/RAWP (see **Attachment 1**) is the process flow diagram that depicts the groundwater extraction from two wells. The following subsections provide more details about the pumps and other components selected. The piping, holding tank, and other appurtenances installation details are described in **Worksheet 17** of the UFP-QAPP**.**

4.a. Extraction Pump Selection

The proposed pneumatic pumps are made of fiberglass body and internal parts consisting of stainless steel and polyvinylidene difluoride which are compatible with the constituents of concern present in the groundwater. The pump specifications are included in **Attachment 1** (Appendix C of the RD/RAWP). The pneumatic pumps operate on compressed air and are capable of extraction rates ranging from 0 to 5 gpm, which will meet the pumping rates expected from these two wells. These pumps expel a known volume of water with each cycle and contain cycle counters to record the quantity of groundwater extracted from each well within a given time period. The existing stickup well boxes will be removed, and the pump controller and connecting piping at each wellhead will be installed in steel well vault measuring approximately 4 feet by 4 feet. A compressor will be connected to an electrical drop near the entrance of the site along Avenue Q, and compressed air lines and water piping will be installed in a trench to the wellheads to operate the pumps. The pump and other equipment installation details are described in **Worksheet 17** of the UFP-QAPP.

The constant rate pumping test performed for the pre-design investigation pumped well 17WW02 at a rate of 0.25 gpm for approximately 48 hours. Steady state drawdown levels were achieved in the pumping well (8.72 feet of drawdown), as well as three nearby piezometers prior to initiating pumping in 17WW01 and 17WW06. At the time steady state was achieved, the drawdown at a distance of 90 feet from the pumping well was approximate 0.25 feet, but the drawdown at a well approximately 150 feet from the pumping well could not be distinguished from background fluctuations. Therefore, the radius of influence for pumping 17WW02 at a rate of 0.25 gpm is conservatively estimated at approximately 100 feet. The pumping rate was limited during the pumping test by the need to avoid running the pump dry and the placement of transducers several feet below the pump. The construction of 17WW02 will allow at least five additional feet of drawdown, which will allow a flow rate higher than 0.25 gpm to be sustained. The pneumatic pumps proposed for use cannot be damaged by running the well dry and can fully dewater the well to maximize the cone of depression around it. The calculations shown on Table 5-2 of the

RD/RAWP estimate that 17WW02 will maintain a pumping rate of 0.4 gpm when fully drawn down, and Figure 5-3 of the RD/RAWP shows a 125 foot estimated radius of influence for the higher pumping rate. Table 5-2 and Figure 5-3 are included in **Attachment 1** for reference.

The second proposed extraction well, 17WW06, was operated at a pumping rate of 1.5 gpm near the end of the pumping test, and the final drawdown was 4.09 feet. The pumping of 17WW06 and 17WW01 showed measurable drawdown at piezometer locations 150 to 180 feet from the wells, indicating that the radius of influence when pumping in the 1.25 to 1.5 gpm range was at least 150 feet. The construction of 17WW06 will allow at least another 6.5 feet of drawdown. Therefore, the calculation on Table 5-2 of the RD/RAWP estimate a pumping rate of 2.5 gpm for 17WW06 and Figure 5-3 of the RD/RAWP shows an estimate radius of influence of 250 feet. Table 5-2 and Figure 5-3 are included in **Attachment 1** for reference.

Monitoring Well 17WW02 may also be used as an extraction well based on the outcome of the baseline sampling. 17WW02 was pumped at a rate of 1.25 gpm at the end of the pumping test and the final drawdown was 11.31 feet. Based on a pumping rate of 1.5 gpm, the radius of influence for 17WW01 is estimated to be 200 feet, as shown on Figure 5-3 of the RD/RAWP. The calculation on Table 5-2 of the RD/RAWP uses the estimated pumping rate of 1.5 gpm for 17WW01. Table 5-2 and Figure 5-3 are included in **Attachment 1** for reference.

It should be noted that various empirically derived formulae for estimating radius of influence provide significantly higher estimated radii of influence for the wells based on the hydraulic conductivity, storativity, and transmissivity values calculated from the pump test. The radii of influence used for 17WW02 and 17WW06 on Table 5-2 and Figure 5-3 of the RD/RAWP are conservatively estimated for this RD based on the observed drawdown measured during the pumping test and will be adequate to capture nearly the full extent of the perchlorate plume exceeding 17 micrograms per Liter (µg/L) as depicted on Figure 5-3 of the RD/RAWP. Table 5-2 and Figure 5-3 are included in **Attachment 1** for reference.

4.b. Extraction/Discharge Piping and Temporary Storage of Groundwater

The groundwater extracted from the extraction wells will be temporarily stored in a 2,500-gallon high density polyethylene pipe (HDPE), double wall holding tank located at LHAAP-17. The holding tank will be placed and anchored to a concrete pad adjacent to the compressor pad. Details of the holding tank are included in **Attachment 1** (Appendix C of the RD/RAWP). The 1-inch diameter HDPE extraction piping from the two wells will be connected to the holding tank. The piping will be buried underground. From the holding tank, 1-inch polyvinyl chloride piping will run above ground to the transfer pump, and this piping will be insulated or heat traced for freeze protection. The 1-inch PVC piping from the transfer pump will be buried and tapped into the existing 4-inch PVC conveyance pipe from LHAAP-16 to the GWTP. If LHAAP-16 is no longer in operation, the conveyance line to the GWTP may be cut and blind flanged. If operation is still ongoing at LHAAP-16, appropriate valves will be installed on the LHAAP-16 conveyance line to prevent any potential backflows. As shown on Figure 5-2 of the RD/RAWP (see **Attachment 1**), the existing high-level sensor in the GWTP equalization tank (currently used to shut down the LHAAP-18/24 wellfield) will be used to trigger shutoff of the transfer pump to avoid overfilling the equalization tank. The holding tank at LHAAP-17 will also be equipped with auto shutoff equipment to shut down pumping from the extraction wells to prevent overfilling the holding tank. The extracted groundwater from the holding tank will be transferred to the GWTP by a transfer pump activated by level sensors.

5. REFERENCES

AECOM. 2016. Draft Final Pre-Design Investigation Work Plan, LHAAP-17 Burning Ground No. 2 / Flashing Area, Group 2. Longhorn Army Ammunition Plant, Karnack, Texas. November.

Aptim Federal Services LLC (APTIM). 2018. Draft Final Pre-Design Investigation Report, LHAAP-17 Burning Ground No. 2/Flash Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas. September.

Bhate Environmental Associates, Inc. (Bhate-APTIM). Final Remedial Design and Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas.

Bhate. 2018b. Installation-Wide Work Plan, Longhorn Army Ammunition Plant, Karnack, Texas.

Shaw Environmental, Inc. (Shaw). 2016. Final Record of Decision, LHAAP-17, Burning Ground No. 2/Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas. August.

ATTACHMENT 1

RELEVANT TABLES, FIGURES, AND APPENDICES FROM RD/RAWP

Tables

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
120	Shallow	12/14/2017	27,000	250	110	65,000
130	Shallow	3/4/2009	31.1	ND	4.29	1,700
		11/14/2017	2.1	ND	ND	2.5
17WW01	Shallow	3/4/2009	6,090	70	35.8	56,000
		9/10/2010	7,160	84.5	45.9	28,000
		11/14/2017	6,100	240	87	< 4
17WW02	Shallow	3/5/2009	867	6.22	34.5	160,000
		9/10/2010	326	3.82	39.3	122,000
		11/15/2017	6.2	< 1	3.3	2,500
17WW03	Shallow	3/5/2009	12.8	< 0.5	0.26 J	< 0.44
		9/10/2010	15.1	< 0.5	0.381 J	2.71
		11/14/2017	5.3	< 1	< 1	< 4
17WW04	Shallow	3/2/2009	0.914 J	< 0.5	< 0.25	< 0.22
		9/10/2010	1.85	1.1	0.282 J	< 0.1
		11/16/2017	< 1	< 1	< 1	< 4
17WW06	Shallow	3/5/2009	176	8.5	5.68	74,000
		9/10/2010	225	7	6.9	86,100
		11/16/2017	260	7.6	8.4	110,000
17WW08	Shallow	2/25/2009	< 0.25	< 0.5	< 0.25	< 0.22
		9/10/2010	< 0.25	NA	< 0.25	< 0.1
		12/16/2013	< 0.5	NA	< 0.5	< 0.159
		12/1/2015	< 0.5	NA	< 0.5	NA
		6/10/2016	< 0.5	< 1	< 0.5	7.13
		12/6/2016	< 0.5	NA	< 0.5	< 0.2
		6/20/2017	< 0.5	< 1	< 0.5	< 0.2
		11/14/2017	< 1	< 1	< 1	< 4
17WW09	Intermediate	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.11
		9/11/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	< 4
17WW10	Shallow	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/10/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	1.6 J
17WW11	Shallow/ Intermediate	2/26/2009	< 0.25	< 0.5	< 0.25	< 0.22
		11/14/2017	< 1	< 1	< 1	< 4
17WW12	Shallow	2/26/2009	< 0.25	< 0.5	< 0.25	290
		3/30/2009	NA	NA	NA	990
		9/11/2010	< 0.25	< 0.5	< 0.25	62.9
		2/15/2018	< 0.5	< 0.5	< 0.5	< 4
17WW13	Shallow	3/3/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/11/2010	< 0.25	< 0.5	< 0.25	< 0.1
		11/14/2017	1.5	< 1	1.5	< 4
17WW14	Shallow	2/25/2009	< 0.25	< 0.5	< 0.25	< 0.55
		9/11/2010	< 0.25	< 0.5	< 0.25	0.196 J
		11/14/2017	< 1	< 1	< 1	2.5 J
17WW17	Intermediate	3/4/2009	10.8	1.92	0.274 J	< 0.22
		9/11/2010	6.34	0.936 J	< 0.25	< 0.1
		11/15/2017	< 1	< 1	< 1	< 4
17WW18	Intermediate	3/3/2009	< 0.25	< 0.5	< 0.25	< 0.44
		9/11/2010	< 0.25	< 0.5	< 0.25	0.708
		11/15/2017	< 1	< 1	< 1	0.595
17WW19	Shallow	1/15/2018	< 1	< 1	< 1	< 4
17WW20	Shallow	5/8/2018	1.6	< 0.5	< 0.5	< 2
18CPTMW22R	Shallow	6/9/2016	< 0.5	NA	NA	0.917
		12/14/2017	< 1	NA	NA	8.3
18WW10	Shallow	4/1/2009	< 0.25	NA	NA	< 0.11
		9/25/2009	< 0.25	NA	NA	< 0.6
		3/11/2010	< 0.25	NA	NA	< 1.2
		9/8/2010	< 0.25	NA	NA	< 1.2
		3/16/2011	< 0.25	NA	NA	< 0.1
		9/14/2011	< 0.25	NA	NA	< 0.1
		3/9/2012	< 0.25	NA	NA	< 0.1
		9/24/2012	< 0.25	NA	NA	< 0.2
		11/15/2017	< 1	< 1	< 1	52
18WW14	Shallow	3/3/2009	< 0.25	NA	NA	< 0.22
		12/2/2015	< 0.5	NA	NA	NA
		11/16/2017	< 1	< 1	< 1	< 4
C-07	Shallow	11/16/2017	< 1	< 1	< 1	4.4

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
MW-7	Shallow	9/20/2011	4,220	NA	NA	49,600
		3/7/2012	4,640	NA	NA	49,300
		9/26/2012	2,130	NA	NA	34,100
		5/14/2013	2,690	NA	NA	37,500
		12/14/2013	2,140	NA	NA	36,700
		8/22/2014	1,680	NA	NA	31,100
		12/17/2014	1,880	NA	NA	32,100
		6/17/2015	1,860	NA	NA	26,800
		12/1/2015	2,730	NA	NA	20,700
		6/24/2016	1,740	NA	NA	22,200
		12/6/2016	1,570	NA	NA	12,300
		6/23/2017	2,230	NA	NA	22,200
		12/13/2017	1,600	< 1	17	15,000
MW-8	Shallow	4/3/2009	1,790	NA	NA	35,000
		9/21/2009	2,200	NA	NA	38,000
		3/9/2010	1,740	NA	NA	34,000
		9/8/2010	1,840	NA	NA	54,000
		3/17/2011	1,140	NA	NA	53,200
		9/15/2011	1,120	NA	NA	64,500
		3/8/2012	1,360	NA	NA	78,000
		9/27/2012	959	NA	NA	72,500
		5/16/2013	907	NA	NA	72,000
		12/19/2013	1,430	NA	NA	63,600
		12/10/2014	1,180	NA	NA	53,200
		6/15/2015	575	NA	NA	40,700
		12/7/2015	487	NA	NA	NA
		6/9/2016	247	NA	NA	8,290
		12/15/2016	245	NA	NA	2,160
		6/16/2017	296	NA	NA	5,320
		12/12/2017	270	< 1	4	5,500
MW-9	Shallow	9/14/2011	5,900	NA	NA	1,780
		3/7/2012	2,240	NA	NA	963
		9/27/2012	5,620	NA	NA	1,340
		5/9/2013	2,400	NA	NA	320
		12/13/2013	1,810	NA	NA	132
		8/21/2014	2,910	NA	NA	1,530
		12/16/2014	3,030	NA	NA	790
		12/1/2015	2,430	NA	NA	NA
		6/22/2016	1,460	NA	NA	263
		12/6/2016	1,250	NA	NA	219
		6/23/2017	661	NA	NA	86.9
		12/11/2017	930	< 1	0.82 J	44
MW-10	Shallow	9/28/2012	0.568 J	NA	NA	< 0.2
		5/8/2013	0.698 J	NA	NA	< 0.2
		12/11/2013	0.554 J	NA	NA	2.74
		6/3/2014	1.01	NA	NA	156
		12/10/2014	0.561 J	NA	NA	< 0.2
		6/11/2015	35.3	NA	NA	3.69
		12/15/2015	4.17	NA	NA	1.26 J
		6/9/2016	0.796 J	NA	NA	0.492
		12/7/2016	0.745 J	NA	NA	< 0.2
		3/20/2017	0.447 J	NA	NA	< 0.2
		6/20/2017	0.701 J	NA	NA	< 0.2
		12/13/2017	< 1	< 1	< 1	< 0.2
MW-16	Shallow	12/8/2017	300	3.6	23	< 0.2
MW-17	Shallow	3/24/2011	0.551 J	NA	NA	0.179 J
		9/15/2011	1.14	NA	NA	< 0.1
		3/9/2012	0.537 J	NA	NA	< 0.1
		9/24/2012	0.943 J	NA	NA	< 0.2
		5/10/2013	0.519 J	NA	NA	< 0.2
		12/16/2013	0.656 J	NA	NA	0.376 J
		6/4/2014	1.69	NA	NA	< 0.2
		12/10/2014	NA	NA	NA	0.143 J
		12/14/2015	NA	NA	NA	24.4 J
		6/20/2016	< 0.5	NA	NA	< 0.2
		12/7/2016	< 0.5	NA	NA	< 0.2
		6/21/2017	< 0.5	NA	NA	< 0.2
		12/11/2017	NA	NA	NA	< 0.2

Table 5-1
Groundwater Analytical Data (2009 to 2018)

Sample Location	Aquifer Zone	Date	Trichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	Perchlorate (µg/L)
MW-18	Shallow	3/3/2009	0.677 J	NA	NA	< 0.11
		7/14/2009	NA	NA	NA	< 4
		9/28/2012	0.5	NA	NA	0.246 J
		5/8/2013	2.57	NA	NA	0.783
		12/18/2013	1.95	NA	NA	< 0.2
		6/13/2014	7.23	NA	NA	0.154 J
		12/23/2014	2.71	NA	NA	< 0.2
		6/22/2015	130	NA	NA	< 2
		12/7/2015	35.9	NA	NA	10.3
		6/17/2016	14.1	NA	NA	< 0.2
		12/15/2016	7.58	NA	NA	< 0.2
		6/21/2017	5.7	NA	NA	< 0.2
		12/11/2017	4.8	< 1	< 1	< 0.2
MW-19	Shallow	7/14/2009	NA	NA	NA	< 3
		9/27/2012	6.07	NA	NA	< 0.2
		5/8/2013	16	NA	NA	< 0.2
		12/17/2013	6.38	NA	NA	< 0.2
		6/13/2014	12.1	NA	NA	0.548
		12/23/2014	31.4	NA	NA	0.229 J
		6/22/2015	31.1	NA	NA	< 2
		12/5/2015	24.6	NA	NA	NA
		6/17/2016	1.82	NA	NA	11.4
		12/21/2016	2.62	NA	NA	< 0.2
		3/22/2017	3.71	NA	NA	< 0.2
		6/20/2017	9.87	NA	NA	< 0.2
		12/12/2017	3.2	< 1	< 1	< 0.2
MW-20	Shallow	4/1/2009	< 0.25	NA	NA	< 0.22
		9/21/2009	< 0.25	NA	NA	< 0.3
		3/8/2010	< 0.25	NA	NA	0.65 J
		9/9/2010	< 0.25	NA	NA	< 0.3
		3/15/2011	0.355 J	NA	NA	< 0.1
		9/13/2011	< 0.25	NA	NA	0.216
		3/7/2012	0.441 J	NA	NA	0.148 J
		6/9/2015	< 0.5	NA	NA	4
		12/6/2016	< 0.5	NA	NA	< 0.2
		12/14/2017	< 1	< 1	< 1	1.9J
MCL / PCL			5	7	5	17

Notes:

µg/L - micrograms per liter

MCL - Safe Drinking Water Act maximum contaminant level (used for trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethane)

PCL - Texas Risk Reduction Program $^{GW}GW_{ING}$ protective concentration level (used for perchlorate)

Concentrations shown in **boldface** type exceed the MCL/PCL

NA - not analyzed

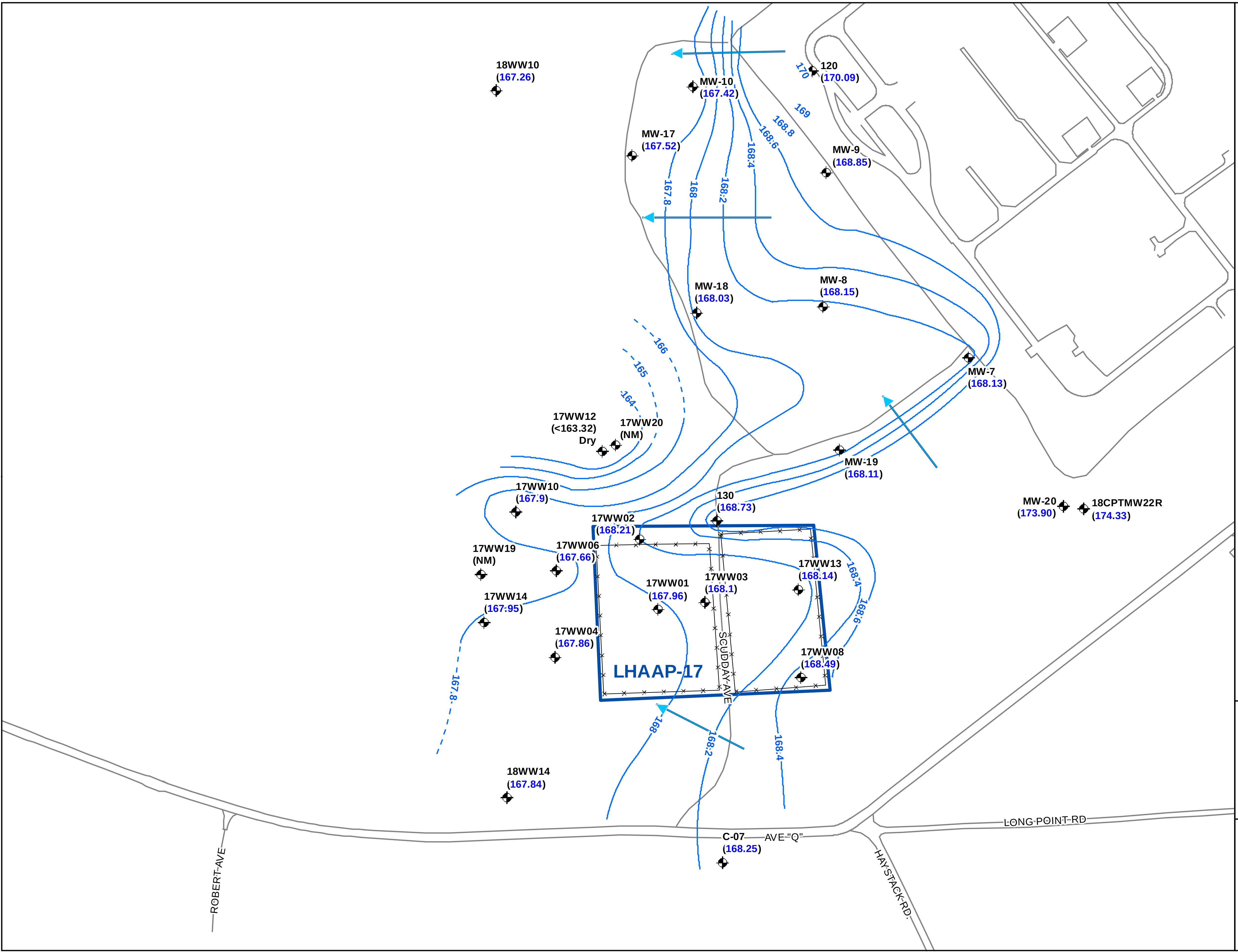
J - concentration shown is estimated

Table 5-2
Estimated Pore Volume and Extraction Volume Calculations

Pore Volume Calculation	
Average Saturated Thickness (feet)	12
Plume Area Based on Figure 5-3 17 µg/L contour (feet^2)	58,000
Estimated Porosity (fine sand) (%)	0.35
Estimated Total Pore Volume (Area x Thickness x porosity) (feet^3)	243,600
Estimated Total Pore Volume (Volume in feet^3 x 7.48) (gallons)	1,822,128

Estimated Extraction Volume Calculation	
17WW02 Projected Pumping Rate (gallons per minute)	0.4
17WW06 Projected Pumping Rate (gallons per minute)	2.5
Minutes/Day	1,440
Total number of Pumping Days (18 months - 10 days down time)	539
17WW02 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	310,464
17WW06 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	1,940,400
Total Projected Volume Extracted (gallons)	2,250,864
Estimated Pore Volumes Removed by 17WW02 and 17WW06 in 18 Months of Extraction	1.24
17WW01 Projected Pumping Rate (gallons per minute)	1.5
Minutes/Day	1,440
Total number of Pumping Days (18 months - 10 days down time)	539
17WW01 Projected Total Extraction Volume (rate x mins/day x days) (gallons)	1,164,240
Estimated Pore Volumes Removed by 17WW01, 17WW02, and 17WW06 in 18 Months of Extraction	1.87

Figures



Shallow Monitoring Well
Groundwater Flow Direction
Groundwater Contour
(Dashed where inferred)
Road
Site Boundary

Notes:
1. LHAAP-17 groundwater elevations were measured between 11/14 and 11/16/2017.
2. LHAAP-18/24 groundwater elevations were measured on 11/30/2017.
3. NM = Not Measured. 17WW20 was installed in April 2018.
4. The groundwater elevations for MW-20 and 18CPTMW22R were not used to draw potentiometric contours because they are screened significantly shallower than other nearby wells and may not represent elevation in the shallow zone.

N
0 100 200
Feet

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Figure 2-1

Shallow Zone Potentiometric Surface
(November 2017)
Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ShallowZoneNov2017.mxd

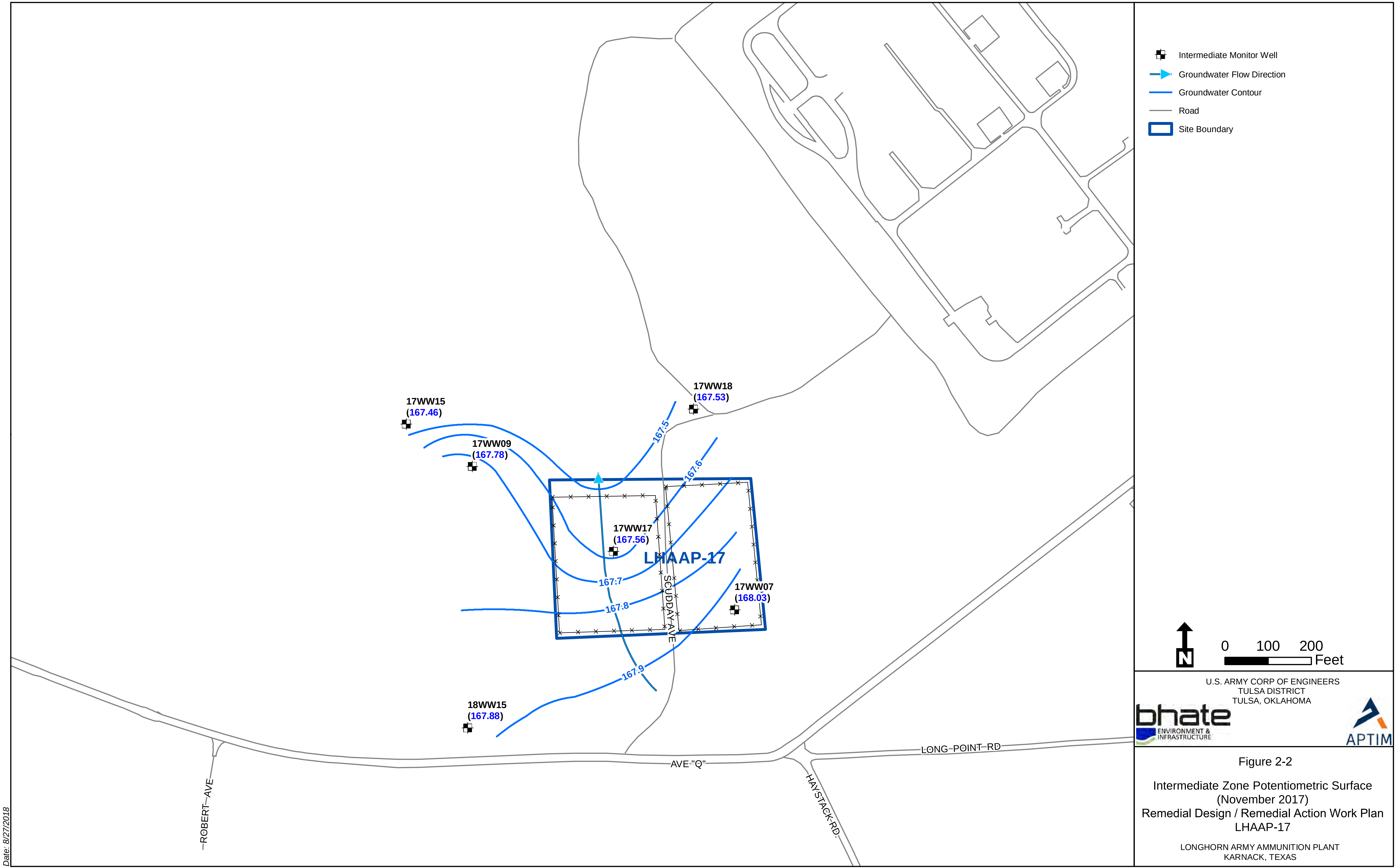

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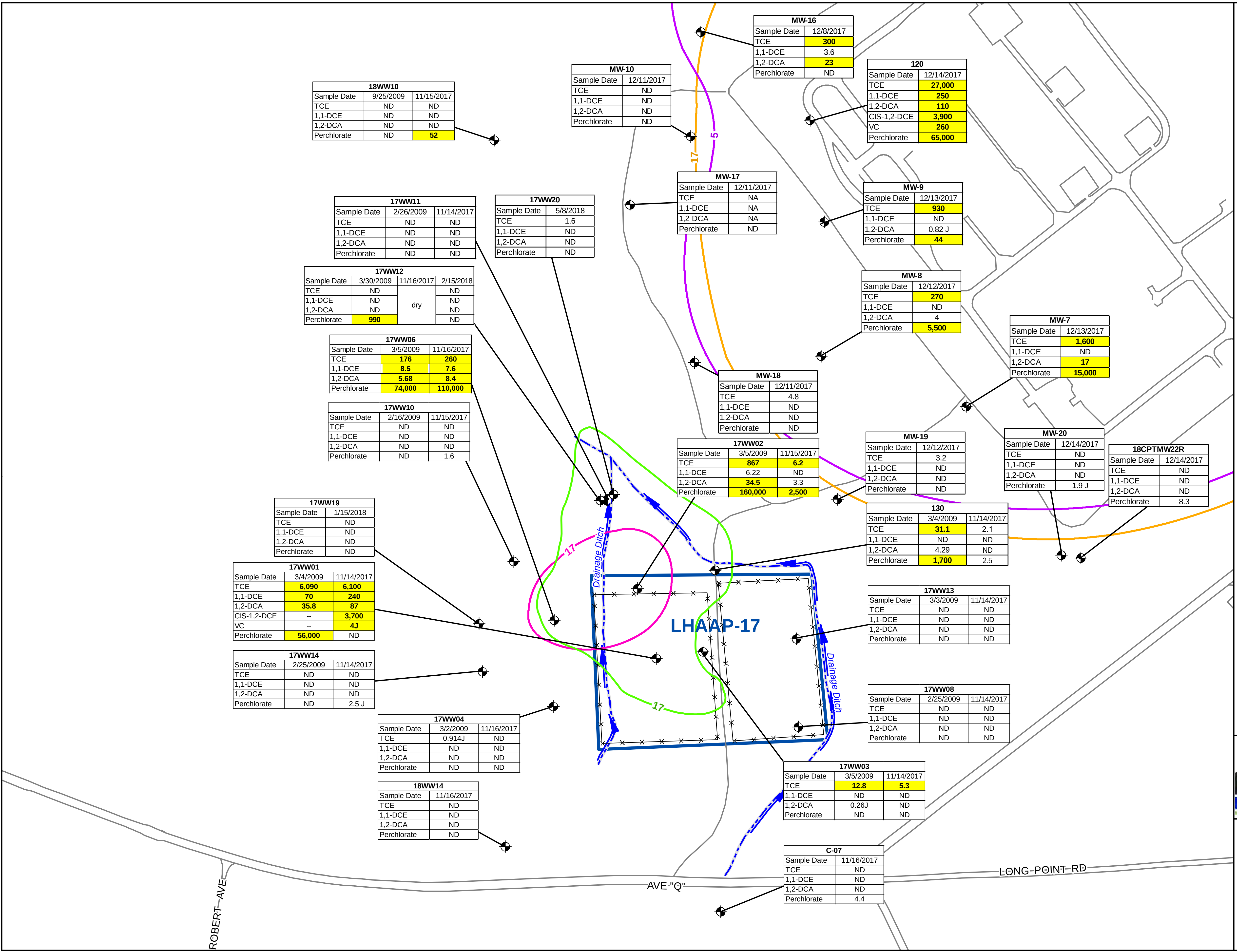
Figure 2-2

Intermediate Zone Potentiometric Surface
(November 2017)
Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 8/27/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\PDI Report\LHAAP17_IntermediateZoneNov2017.mxd



18WW10		
Sample Date	9/25/2009	11/15/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	**52**

MW-10	
Sample Date	12/11/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

MW-16	
Sample Date	12/8/2017
TCE	**300**
1,1-DCE	3.6
1,2-DCA	**23**
Perchlorate	ND

120	
Sample Date	12/14/2017
TCE	**27,000**
1,1-DCE	**250**
1,2-DCA	**110**
CIS-1,2-DCE	**3,900**
VC	**260**
Perchlorate	**65,000**

MW-17	
Sample Date	12/11/2017
TCE	NA
1,1-DCE	NA
1,2-DCA	NA
Perchlorate	ND

MW-9	
Sample Date	12/13/2017
TCE	**930**
1,1-DCE	ND
1,2-DCA	0.82 J
Perchlorate	**44**

17WW11		
Sample Date	2/26/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW20	
Sample Date	5/8/2018
TCE	1.6
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

17WW12			
Sample Date	3/30/2009	11/16/2017	2/15/2018
TCE	ND	dry	ND
1,1-DCE	ND		ND
1,2-DCA	ND		ND
Perchlorate	**990**		ND

MW-8	
Sample Date	12/12/2017
TCE	**270**
1,1-DCE	ND
1,2-DCA	4
Perchlorate	**5,500**

MW-7	
Sample Date	12/13/2017
TCE	**1,600**
1,1-DCE	ND
1,2-DCA	**17**
Perchlorate	**15,000**

17WW06		
Sample Date	3/5/2009	11/16/2017
TCE	**176**	**260**
1,1-DCE	**8.5**	**7.6**
1,2-DCA	**5.68**	**8.4**
Perchlorate	**74,000**	**110,000**

MW-18	
Sample Date	12/11/2017
TCE	4.8
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

17WW10		
Sample Date	2/16/2009	11/15/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	1.6

17WW02		
Sample Date	3/5/2009	11/15/2017
TCE	**867**	**6.2**
1,1-DCE	6.22	ND
1,2-DCA	**34.5**	3.3
Perchlorate	**160,000**	**2,500**

MW-19	
Sample Date	12/12/2017
TCE	3.2
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

MW-20	
Sample Date	12/14/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	1.9 J

18CPTMW22R	
Sample Date	12/14/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	8.3

17WW19	
Sample Date	1/15/2018
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

130		
Sample Date	3/4/2009	11/14/2017
TCE	**31.1**	2.1
1,1-DCE	ND	ND
1,2-DCA	4.29	ND
Perchlorate	**1,700**	2.5

17WW01		
Sample Date	3/4/2009	11/14/2017
TCE	**6,090**	**6,100**
1,1-DCE	**70**	**240**
1,2-DCA	**35.8**	**87**
CIS-1,2-DCE	--	**3,700**
VC	--	**4J**
Perchlorate	**56,000**	ND

17WW13		
Sample Date	3/3/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW14		
Sample Date	2/25/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	2.5 J

17WW08		
Sample Date	2/25/2009	11/14/2017
TCE	ND	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW04		
Sample Date	3/2/2009	11/16/2017
TCE	0.914J	ND
1,1-DCE	ND	ND
1,2-DCA	ND	ND
Perchlorate	ND	ND

17WW03		
Sample Date	3/5/2009	11/14/2017
TCE	**12.8**	**5.3**
1,1-DCE	ND	ND
1,2-DCA	0.26J	ND
Perchlorate	ND	ND

18WW14	
Sample Date	11/16/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	ND

C-07	
Sample Date	11/16/2017
TCE	ND
1,1-DCE	ND
1,2-DCA	ND
Perchlorate	4.4

⊕ Shallow Monitoring Well
◐ Shallow/Intermediate Monitoring Well
〜 LHAAP-17 2009 Perchlorate Contour (PCL = 17 µg/L)
〜 LHAAP-17 2017-2018 Perchlorate Contour (PCL = 17 µg/L)
〜 LHAAP-18/24 December 2017 Perchlorate Contour (PCL = 17 µg/L) (Bhate 2018a)
〜 LHAAP-18/24 December 2017 TCE Contour (MCL = 5 µg/L) (Bhate (2018a)
— Road
◀ Surface Water Flow Direction
-·- Drainage Ditch
▭ Site Boundary

Notes:
1. All concentrations are reported in microgram per liter (µg/L).
2. ND - non detect; detection limit below MCL/PCL
NA - not analyzed
3. Highlighted concentrations indicate levels above cleanup
4. TCE - trichloroethene (MCL = 5 µg/L)
5. 1,1-DCE - 1,1-dichloroethene (MCL = 7 µg/L)
6. 1,2-DCA - 1,2-dichloroethane (MCL = 5 µg/L)
7. cis-1,2-DCE - cis-1,2-dichloroethene (MCL = 70 µg/L)
8. VC - Vinyl Chloride (MCL = 2 µg/L)
9. PCL - Texas Risk Reduction Program Protective Concentration Level
10. MCL - Safe Drinking Water Act Maximum Contaminated Level
11. The LHAAP-17 2017-2018 Perchlorate contour is based on data collected between November 2017 and May 2018.
12. The LHAAP-18/24 December 2017 TCE and Perchlorate contours are from the Draft Quarterly Evaluation Report, 4th Quarter (October-December) 2017 (Bhate 2018a).

N
0 100 200
Feet

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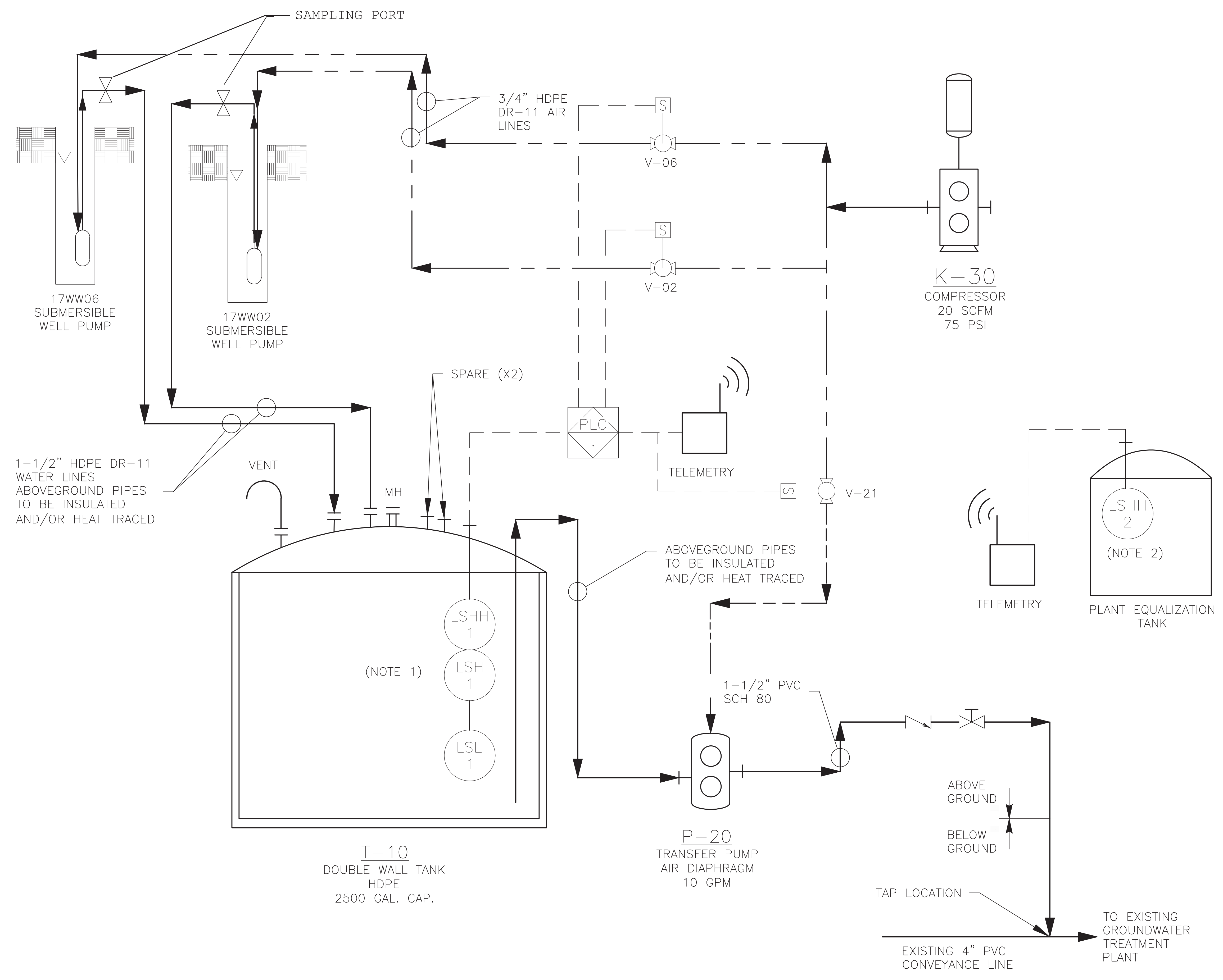
Figure 5-1

COC Concentrations Detected in Shallow Groundwater - 2009 and 2017

Remedial Design / Remedial Action Work Plan
LHAAP-17
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 8/27/2018

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\PDI Report\LHAAP17_COC_ShWater_2009_2017.mxd



LEGEND:

———	WATER LINE
— - —	AIR LINE
— — —	SIGNAL/COMMUNICATION LINE
S	SOLENOID VALVE
⋈	HAND VALVE
↘	CHECK VALVE
LSHH X	LEVEL SWITCH HIGH-HIGH
LSH X	LEVEL SWITCH HIGH
LSL X	LEVEL SWITCH LOW
HDPE	HIGH DENSITY POLYETHYLENE
PVC	POLYVINYL CHLORIDE
SCFM	STANDARD CUBIC FEET PER MINUTE
PSI	POUNDS PER SQUARE INCH
GPM	GALLONS PER MINUTE
MH	MANHOLE

NOTES:

1. LSHH1 CLOSES V-02 AND V-06
   LSH1 OPENS V-21
   LSL1 CLOSES V-21
2. LSHH2 CLOSES V-21
3. 17WW01 WILL BE ADDED AS AN EXTRACTION WELL USING THE SAME DESIGN AS 17WW02 AND 17WW06 IF THE BASELINE SAMPLE PERCHLORATE CONCENTRATION EXCEEDS 20,000 MICROGRAMS PER LITER

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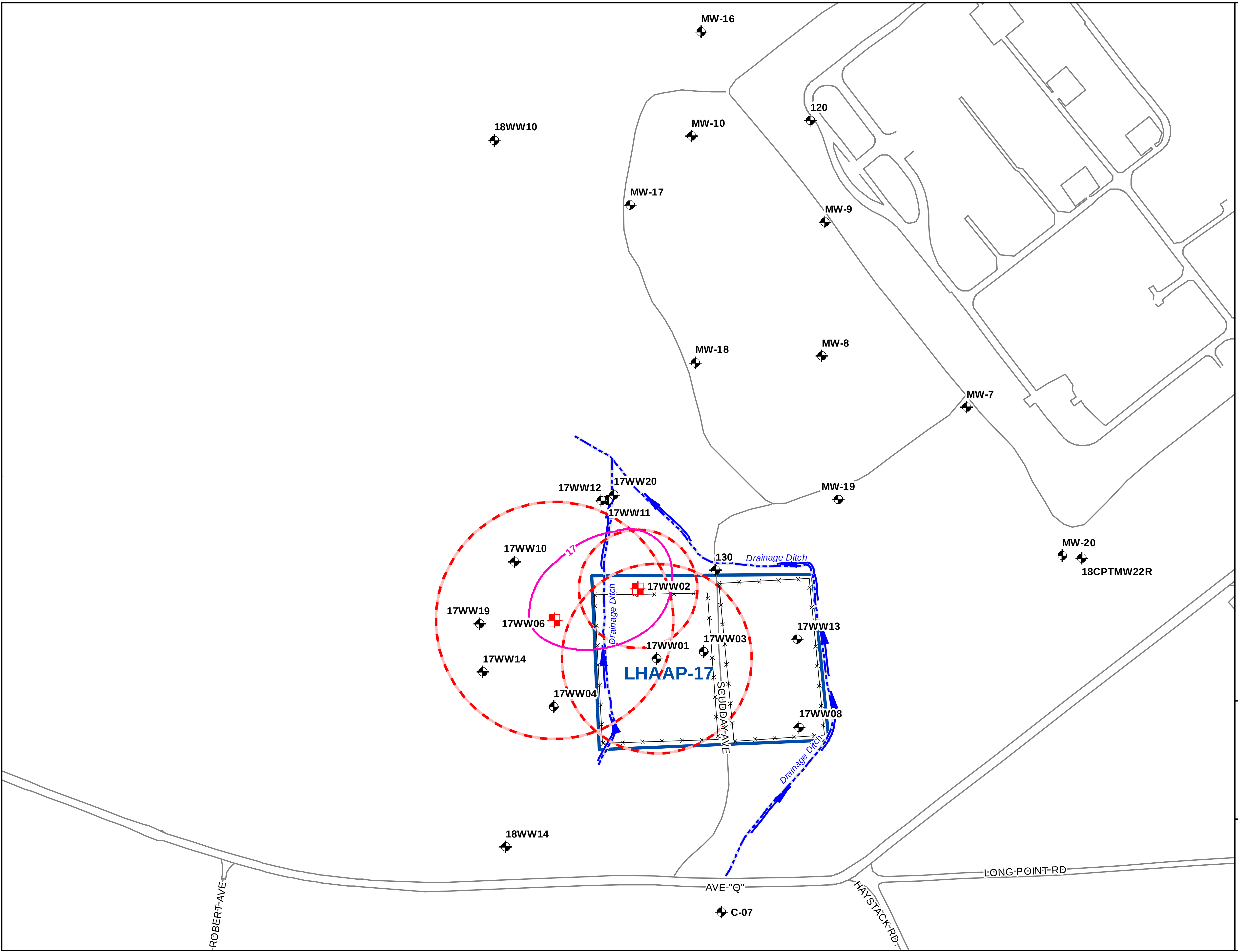
FIGURE 5-2

Groundwater Extraction Process Flow Diagram
Remedial Design / Remedial Action Work Plan
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

File: 501032-PFD1.dwg
Plot Date/Time: Nov 09, 2018 - 10:39am
Plotted By: samantha.bentley



🟥 Proposed Extraction Well

✦ Shallow Monitoring Well

◐ Shallow/Intermediate Monitoring Well

~ LHAAP-17 2017-2018 Perchlorate Contour (PCL = 17 µg/L)

— Road

▭ Radius of Influence

← Surface Water Flow Direction

-·- Drainage Ditch

▭ Site Boundary

N

0 100 200 Feet

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Figure 5-3

Estimated Radius of Influence
for Extraction Wells
Remedial Design/Remedial Action Work Plan, LHAAP-17
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_EstimatedROIforExtractionWells.mxd

Notes:
17WW02 and 17WW06 are the planned extraction wells, but 17WW01 may be added as an extraction well based on the results of the baseline sampling discussed in Section 5.5 of the Remedial Design/Remedial Action Work Plan (RD/RAWP), LHAAP-17 Burning Ground No. 2/ Flashing Area, Group 2, Longhorn Army Ammunition Plant, Karnack, Texas (Bhate Environmental Associates, Inc. [Bhate] 2019)

The holding tank location proposed in the RD/RAWP (Bhate, 2019) has been updated based on site conditions identified during a site walk conducted on July 21, 2021. The final location will be reported in the RACR.

N

0 80 160 320 Feet

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FIGURE ES-4

GROUNDWATER EXTRACTION SYSTEM LAYOUT
REMEDIAL DESIGN / REMEDIAL ACTION
WORK PLAN
LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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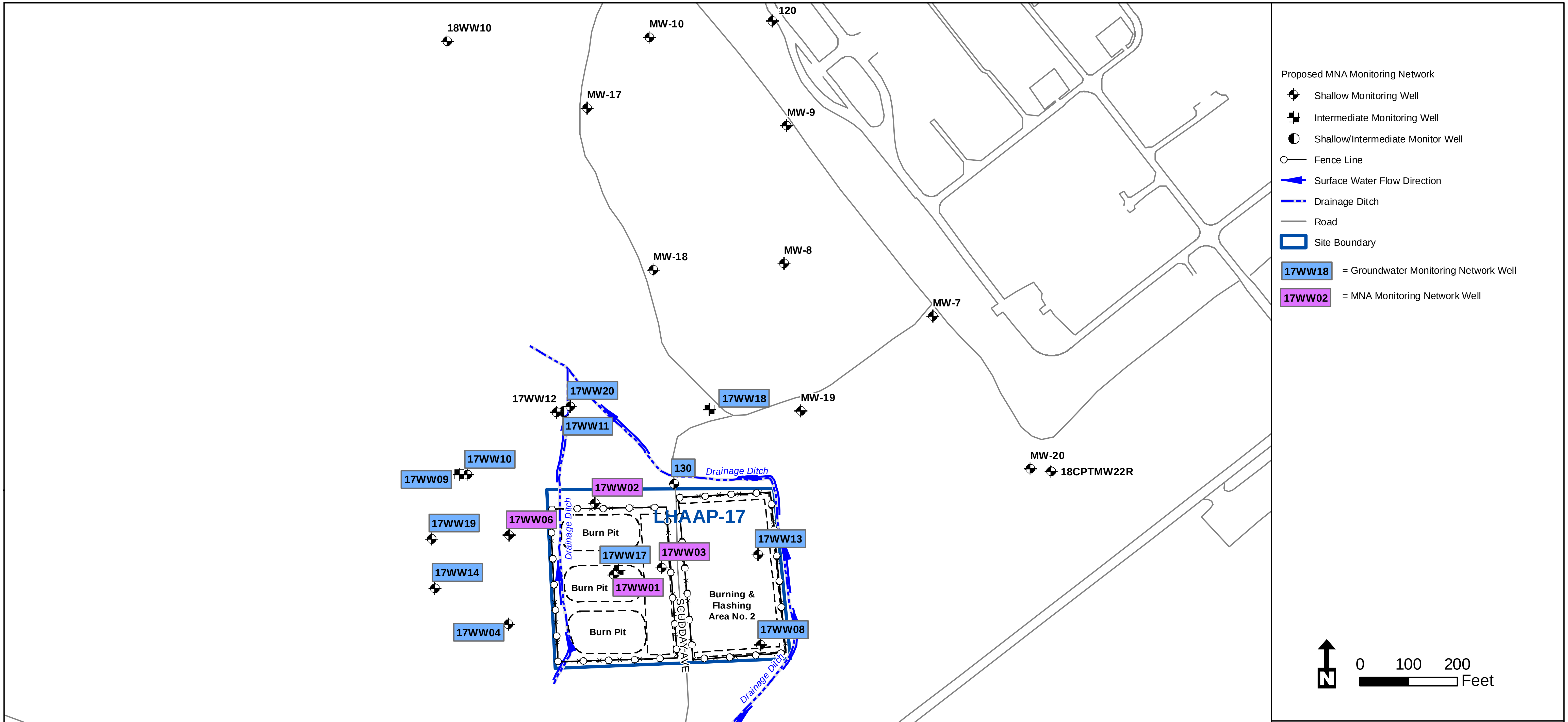

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Figure 8-1

Proposed MNA Monitoring Network

Remedial Design/Remedial Action Work Plan, LHAAP-17

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/27/2019

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP17\RD\LHAAP17_ProposedMNAMonitoringNetwork.mxd

Appendices

Appendix C

Groundwater Extraction Pump and Holding Tank Specification Sheets

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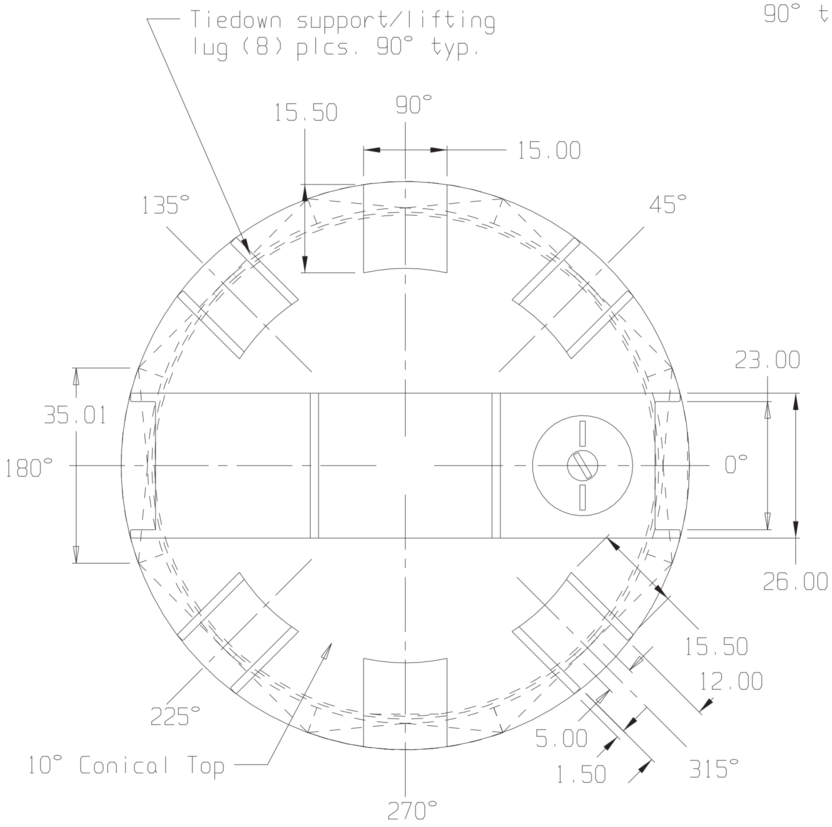

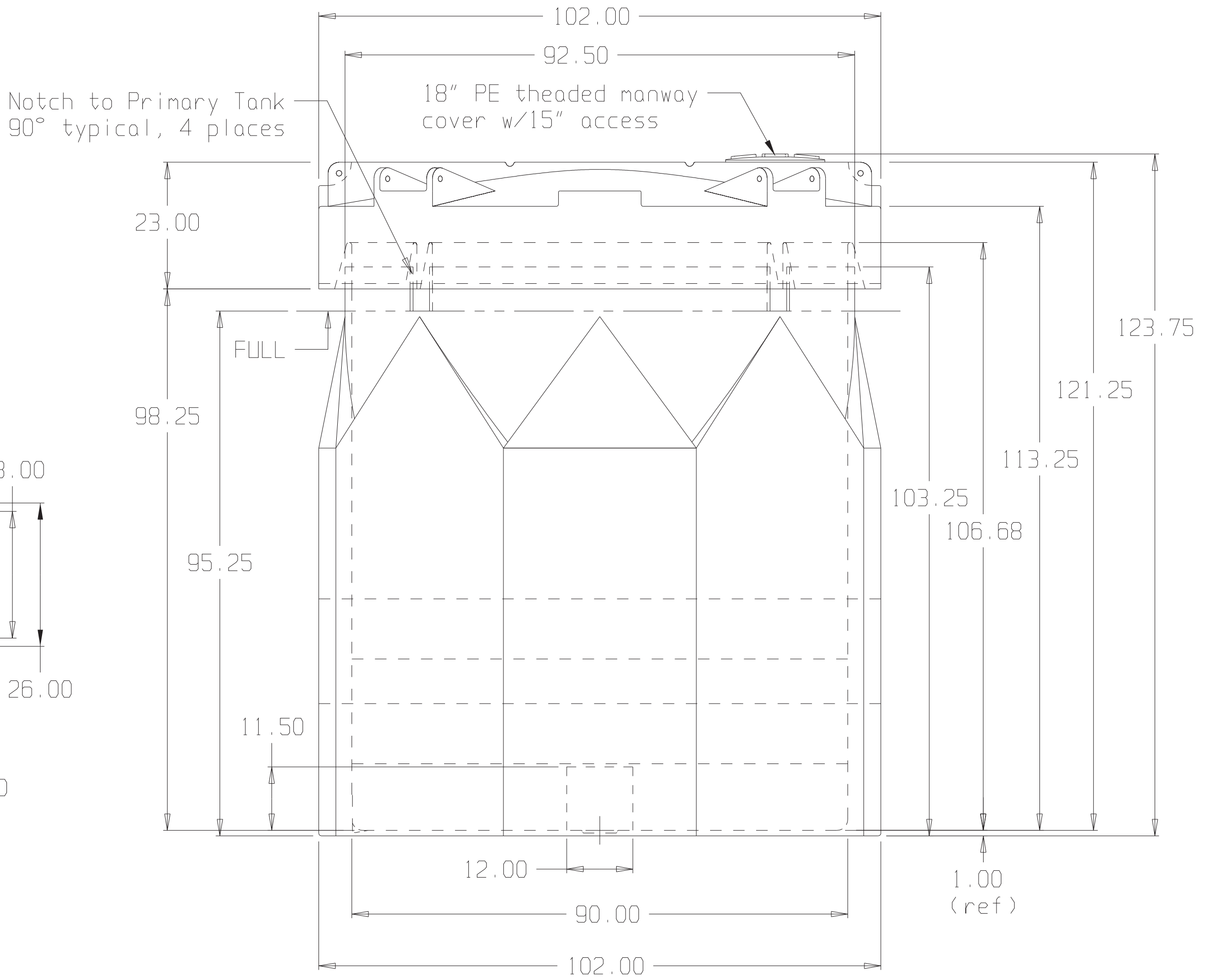

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(all dimensions in inches)

BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER Sii PROCEDURE

2,500 GALLON CAPTOR CONTAINMENT SYSTEM

PART # PRIMARY: 5580--

CONTAINMENT: 5510--

REF#: 0000

07/29/02

2500 Gallon Double Wall Tank

Wrap Option: Select a Wrap Option

Price: **$6,899.99**

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$190 / month

Part Number:	SII-CCS2500
Mfr. Part Number:	5580000N-45
Capacity:	2500 Gallons
Dimensions:	102" dia. x 123-3/4"H
Weight:	1420 lbs.
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USD Shipping:	Call For Shipping Rate 866 310 2556 or Email
PDF Drawing:	View Technical Drawing
Manufacturer:	Snyder Industries
Material:	Polyethylene
Availability:	In Stock *(Stock changes daily please call to confirm)*

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Shown With Accessories : Sold Separately

2500 Gallon Captor Double Wall Liquid Storage Tank - 1.9 Specific Gravity

2500 Gallon Snyder Industries Captor Double Wall Liquid Storage Tank Includes:

- 18" Threaded Manway Comes Standard (Bolted and Threaded Manways are available in sizes up to 24" by request.)
- Molded In Tie-Down Lugs (interface with optional cable restraint system to meet seismic and 150 mph wind load requirements.)
- Provides 115%-120% containment of inner tank's capacity.
- Resin complies with U.S. Food and Drug Administration regulation 21 CFR 177.1570 (c) 3.1 and 3.2.
- Through tank fittings available by request.
- Outer containment of the double wall tank complies with federal regulation 40CFR-264.193 capacity requirements.

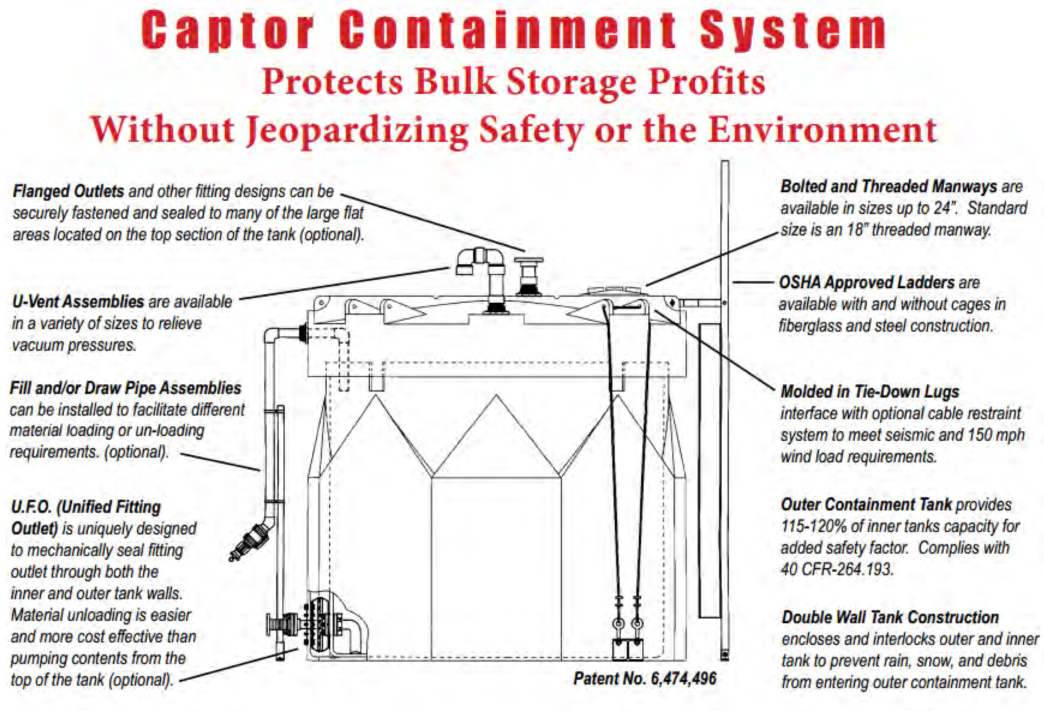
This tank is made from High Density Linear Polyethylene. It is also made in crosslinked linear polyethylene by request.

Optional Fittings Include:

- Flanged Outlets (Can be securely fastened and sealed to many of the large flat areas located on the top section of the tank.
- Fill and/or Draw Pipe Assemblies (can be installed to facilitate different material loading or un-loading requirements.)
- U Vent Assemblies (available in a variety of sizes to relieve vacuum pressures.)
- U.F.O. (Unified Fitting Outlet)(uniquely designed to mechanically seal fitting outlet through both the inner and outer tank walls. Material unloading is easier and more cost effective than pumping contents from the top of the tank.)
- OSHA Approved ladders are available with and without cages in fiberglass and steel construction.
- Double Wall Tank Construction encloses and interlocks outer and inner tank to prevent rain, snow, and debris from entering outer containment tank.

Captor Double Wall liquid storage tanks can not be pressurized. This double wall liquid storage tank can hold liquids with a material weight up to 15.83 lbs. per gallon (1.9 specific gravity rating). (Water weighs 8.34 pounds)

Underground Water Storage Tanks (Cisterns)
Underground Water Tanks
RV Water & Waste Holding Tanks
RV Fresh Water Tanks
RV Holding Tanks
Marine Water & Waste Holding Tanks for Boats
Marine Water Storage Tanks for Boats
Marine Holding Tanks
Marine Fuel Tanks
Water & Liquid Storage Tanks
Plastic Water Tanks
Plastic Storage Tanks
Cone Bottom Tanks
Horizontal Hauling & Storage Tanks
Water Pumps
Low Profile Hauling & Storage Tanks
Flat Bottom Portable Water Tanks
Truck Bed Water Tanks Specials
Rectangular Water & Waste Tanks
Double Wall Tanks
Plastic Stock Tanks - Water Troughs
Elliptical Cradle Tanks
Auto Detailing Tanks
Doorway Water Tanks (29")
PCO Liquid Transport Tanks
Stackable Water Tanks
Brine Storage Tanks
Forkliftable Water Tanks
Stackable Oil Storage Totes
Fuel Tanks
Plastic Open Top Tanks
Open Top Cylindrical Tanks
Open Top Rectangular Tanks
Open Top Cone Bottom Tanks
Plastic Septic Tanks for Sale
Plastic Septic Tanks
Norwesco Bruiser Tanks
Job Shack Holding Tanks
Secondary Containment
Spill Containment Trays
Secondary Containment Basins
Bulkhead Fittings - Lids - Gaskets
Ball Valves
Bulkhead Fittings
Strainer Baskets
Lids
Inspection Lids
Gaskets
Water Tank Float Valves
Siphon Tubes
Baffle Balls - Surgebusters
Pipe Plugs
Heat Blankets
Polypropylene Tanks



Captor Containment System

Protects Bulk Storage Profits Without Jeopardizing Safety or the Environment

Flanged Outlets *and other fitting designs can be securely fastened and sealed to many of the large flat areas located on the top section of the tank (optional).*

U-Vent Assemblies *are available in a variety of sizes to relieve vacuum pressures.*

Fill and/or Draw Pipe Assemblies *can be installed to facilitate different material loading or un-loading requirements. (optional).*

U.F.O. (Unified Fitting Outlet) *is uniquely designed to mechanically seal fitting outlet through both the inner and outer tank walls. Material unloading is easier and more cost effective than pumping contents from the top of the tank (optional).*

Bolted and Threaded Manways *are available in sizes up to 24". Standard size is an 18" threaded manway.*

OSHA Approved Ladders *are available with and without cages in fiberglass and steel construction.*

Molded in Tie-Down Lugs *interface with optional cable restraint system to meet seismic and 150 mph wind load requirements.*

Outer Containment Tank *provides 115-120% of inner tanks capacity for added safety factor. Complies with 40 CFR-264.193.*

Double Wall Tank Construction *encloses and interlocks outer and inner tank to prevent rain, snow, and debris from entering outer containment tank.*

Patent No. 6,474,496

Simplex Part Number: CCS2500-1.9

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AP4+B

Bottom Inlet, Short

Max. Flow	13 gpm (49 lpm)
O.D.	3.6 in. (9.1 cm)
Length	39.3 in. (100 cm)

Description

The AP4+ Bottom Inlet Short AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and/or the need to pump down to lower water levels, compared to full-length pumps. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 13 gpm (49 lpm)*. The AP4+ Short Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site-specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Bottom Inlet Short AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

Advantages

1. **The original automatic air-powered well pump, proven worldwide over 25 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

***Consult QED for higher flow requirements**

QED
Environmental Systems

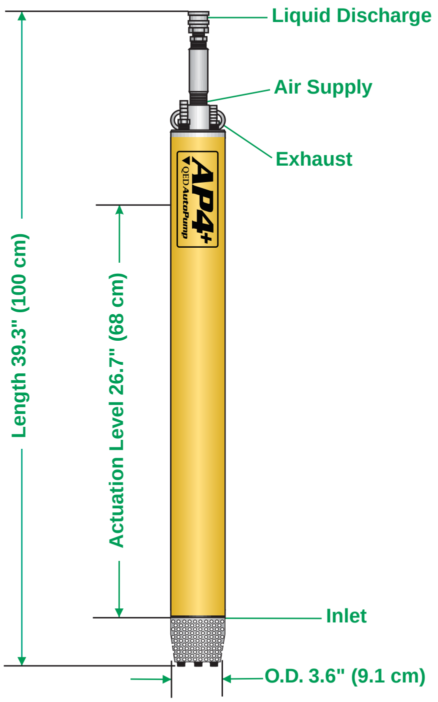
00915983

AutoPump®

Bottom Inlet, Short

AP4+B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Short AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
OD	3.6 in. (9.1 cm)
Length Overall (pump & fittings)	39.3 in. (100 cm)
Weight	13 lbs. (5.9 kg)
Max. Flow Rate	13 gpm (49 lpm)* - See Flow Rate Chart
Pump Volume / Cycle	0.22 - 0.36 gal (.83 - 1.36L)
Min. Actuation Level	26.7 in. (68 cm)
Standard Pump	
Max. Depth	250 ft. (76 m)
Air Pressure Range	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.4-1.5 scf / gal. (1.5 - 5.7 liters of air / fluid liter) - See Air Usage Chart
High Pressure Pump	
Max. Depth	425 ft. (130 m)
Air Pressure Range	5 - 200 psi (0.4 - 14.1 kg/cm2)
Min. Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF[3]
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs or Quick Connects
Tube & Hose Options	
Tubing Material[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available

[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

[3] PVDF - Polyvinylidene Fluoride

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4 upgrades.

Maximum Temperature: 150°F (65°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6, #2 heating oils, BTEX, MTBE, landfill liquids

***Consult QED for higher flow requirements**

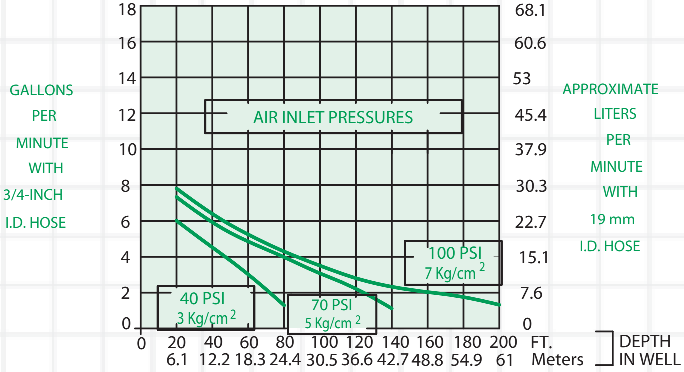
Long and Short AP4+ AutoPumps are warranted for five (5) years: 100% materials and workmanship.

Low-Drawdown AutoPumps are warranted for one (1) year: 100% materials and workmanship.

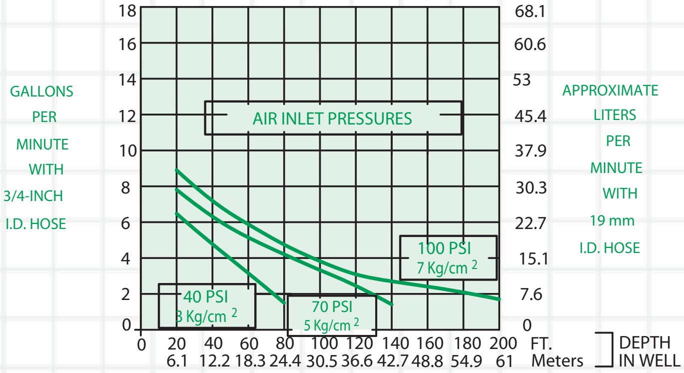
Flow Rates[1]

3/4 inch (19 mm)
Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)

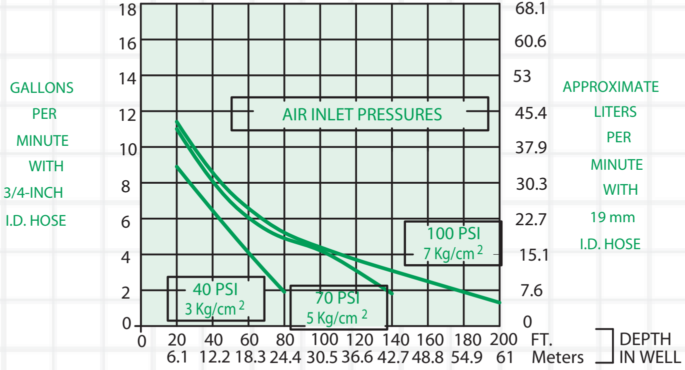
6-INCH (15 cm) SUBMERGENCE OF PUMP HEAD



2 FT. (60 cm) SUBMERGENCE OF PUMP HEAD

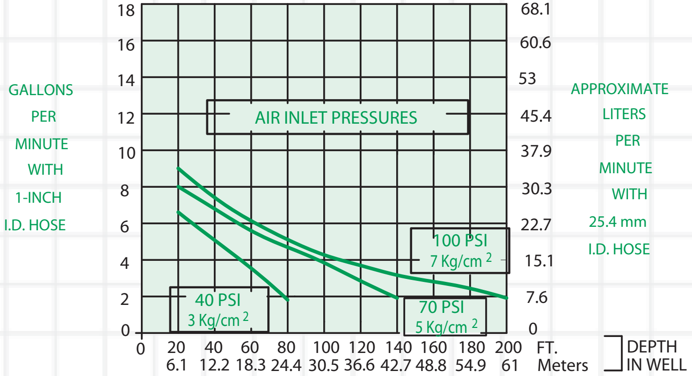


10 FT. (300 cm) SUBMERGENCE OF PUMP HEAD

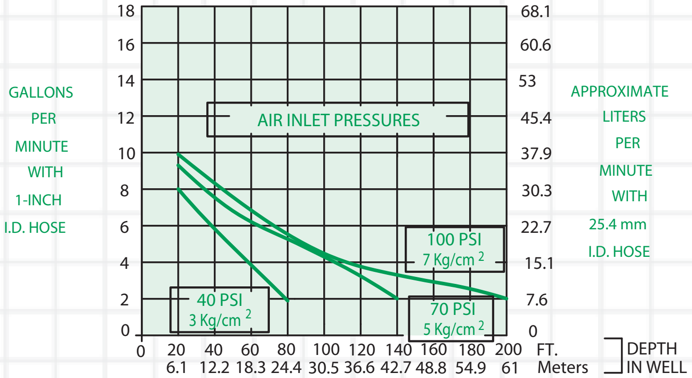


1 inch (25.4 mm)
Inside Diameter Discharge Hose
(Equivilant to 1.25-Inch O.D. Tubing)

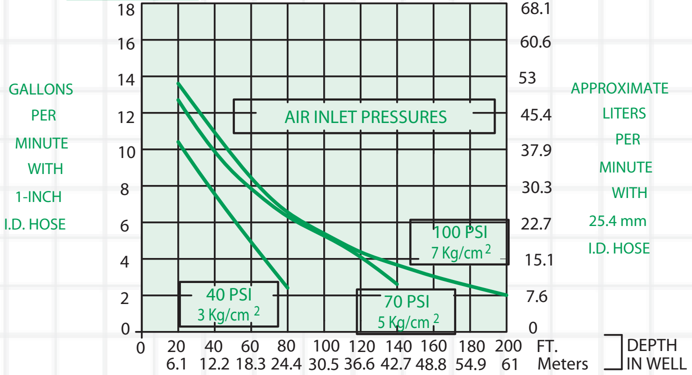
6-INCH (15 cm) SUBMERGENCE OF PUMP HEAD



2 FT. (60 cm) SUBMERGENCE OF PUMP HEAD



10 FT. (300 cm) SUBMERGENCE OF PUMP HEAD



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[1] FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

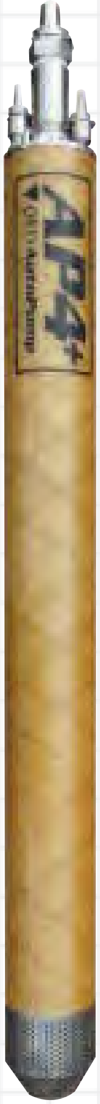
AutoPump®

Bottom Inlet, Short

00915985

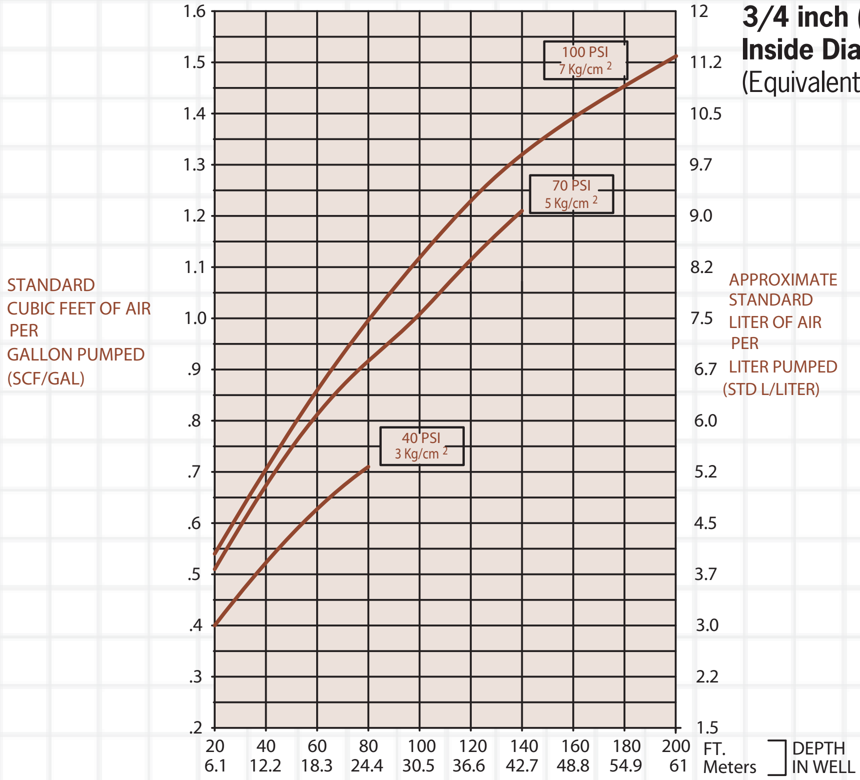
AP4+B

Air Consumption



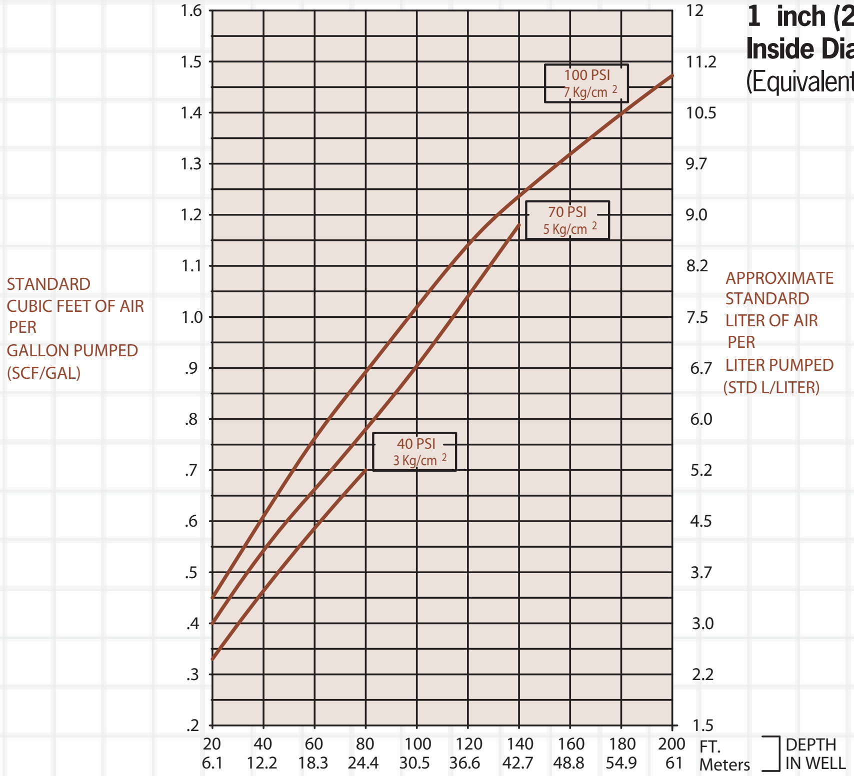
3/4 inch (19 mm) Inside Diameter Discharge Hose

(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose

(Equivalent to 1.25-Inch O.D. Tubing)



Appendix D

Operation and Maintenance Forms

RAO Inspection and Maintenance Checklist

General Information	
Project Name	RAO Inspection and Maintenance, LHAAP-17, Longhorn Army Ammunition Plant, Karnack, TX
Contractor	
Inspector’s Name	
Inspector’s Title	
Inspector’s Signature	
Inspector’s Contact Number	
Inspection Date	
Type of Inspection	☐ Quarterly ☐ Semiannual ☐ Annual ☐ Prior to forecast rain ☐ After a rain event ☐ Other --------------------------------

A.	**Groundwater Monitoring Wells**					
D.1	Are the installed groundwater monitoring wells in poor condition?					
D.2	Is the well cleared of vegetation and accessible?					
D.3	Any other relevant observations?					
D.4	Are there any significant cracks present?					
D.5	Are there any damaged areas?					

LHAAP-17
Weekly Extraction System Tracking and Maintenance Form

Date	Time	Inspector	17WW02 Volume (gallons)	17WW06 Volume (gallons)	Compressor Pressure (PSI)	Well Head Check	Tanks and Transfer Pump	Tank/Compressor/Pump Notes and Maintenance Performed
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	
						Secure Y/N **Leaks Y/N**	**Secure Y/N** **Leaks Y/N**	