Uniform Federal Policy - Quality Assurance Project Plan

Military Munitions Response Program Remedial Investigation

Iona Island Naval Ammunition Depot Formerly Used Defense Site Stony Point, Rockland County, New York

Contract No. W912DR-15-D-0014
Delivery Order No. W912DR17F0180

Prepared for

United States Army Corps of Engineers
Baltimore District

Prepared by

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LIST OF ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
%	Percent
%R	Percent recovery
AGC	Advanced geophysical classification
ANJV	Acorn SI-NAEVA Joint Venture
AOC	Area of concern
APP	Accident Prevention Plan
ASR	Archive Search Report
AST	Aboveground storage tank
B.A.	Bachelor of Arts
bgs	Below ground surface
B.S.	Bachelor of Science
CA	Corrective action
CAR	Corrective Action Report
CAS	Chemical Abstracts Service
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIH	Certified Industrial Hygienist
CM	Centimeter(s)
COD	Coefficient of determination
CON/HTRW	Containerized Hazardous Toxic and Radioactive Waste
COPC	Contaminant of potential concern
COR	Contracting Officer Representative
CPR	Cardiopulmonary resuscitation
CRP	Community Relations Plan
CSM	Conceptual site model
CSP	Certified Safety Professional
CVAA	Cold vapor atomic absorption
CX	Center of Expertise
DDESB	Department of Defense Explosives Safety Board
DER	Division of Environmental Remediation
DERP	Defense Environmental Restoration Program
DFW	Definable feature of work
DGM	Digital geophysical mapping
DL	Detection limit
DMM	Discarded military munitions
DNT	Dinitrotoluene
DoD	Department of Defense

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

DQI	Data quality indicator
DQO	Data quality objective
DU	Decision unit
DUA	Data Usability Assessment
EA	EA Engineering, P.C. and Its Affiliate EA Science and Technology
EM	Electromagnetic
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ER	Engineer Regulation
ESP	Explosives Site Plan
FS	Feasibility study
ft	Foot (feet)
FUDS	Formerly Used Defense Site
GIS	Geographic information system
GPS	Global positioning system
GSA	General Services Administration
HAZWOPER	Hazardous Waste Operations and Emergency Response
HFD	Hazardous fragment distance
HPLC	High performance liquid chromatography
HTRW	Hazardous, Toxic, and Radioactive Waste
IAW	In accordance with
ICAL	Initial calibration
ICP	Inductively coupled plasma
ID	Identification
in.	Inch(es)
IRP	Installation Restoration Program
ISM	Incremental sampling methodology
ISO	Industry standard object
ISTD	Internal standard
ITR	Independent Technical Review
IVS	Instrument verification strip
KO	Contracting Officer
LCS	Laboratory control sample
LOD	Limit of detection
LOQ	Limit of quantitation

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

MC	Munitions constituents
MD	Munitions debris
MDAS	Material documented as safe
MDEH	Material determined an explosive hazard
MDL	Method detection limit
MEC	Munitions and explosives of concern
mg/kg	Milligram(s) per kilogram
mm	Millimeter(s)
MMRP	Military Munitions Response Program
MPPEH	Material potentially presenting an explosive hazard
MPS	Milestone Payment Schedule
MQO	Measurement quality objective
MRS	Munitions Response Site
M.S.	Master of Science
MS	Matrix spike
MSD	Matrix spike duplicate
N/A	Not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-detect
NMRD	Non-munitions-related debris
No.	Number
NS	No standard
NV	Not validated
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
oz	Ounce(s)
PA	Preliminary Assessment
PAL	Project Action Limits
PDF	Portable document format
PDT	Project delivery team
P.E.	Professional Engineer
P.G.	Professional Geologist
Ph.D.	Doctor of Philosophy
PIPC	Palisades Interstate Park Commission
PLS	Professional Land Surveyor
PM	Project Manager
PMP	Project Management Plan
POC	Point-of-contact

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

QA	Quality assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	Quality control
QCS	Quality Control Supervisor
QSM	Quality Systems Manual
RCA	Root Cause Analysis
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RPD	Relative percent difference
RSD	Relative standard deviation
RSL	Regional Screening Level
RTK	Real-time kinematic
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SME	Sporadic marginal exceedance
SNR	Signal to noise ratio
SOP	Standard Operating Procedure
SR	Sample result
SSHP	Site Safety and Health Plan
SSR	Spike sample results
SUXOS	Senior Unexploded Ordnance Supervisor
TBD	To be determined
TNT	Trinitrotoluene
TOI	Target of interest
TPP	Technical Project Planning
TSCA	Toxic Substances Control Act
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UST	Underground storage tank
UXO	Unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

VE	Validation electronic
VEM	Validation electronic and manual
VSP	Visual Sampling Plan
WP	Work Plan

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INTRODUCTION

EA Engineering, P.C. and Its Affiliate EA Science and Technology (EA)[1] has prepared this Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) in support of the Military Munitions Response Program (MMRP) Remedial Investigation (RI) being conducted at the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS), located in Stony Point, Rockland County, New York (NY) (FUDS Project Number [No.] C02NY074403) (Figure 1). The work is being performed under W912DR-15-D-0014 Delivery Order No. W912DR18F0587, under the oversight of the U.S. Army Corps of Engineers (USACE) Baltimore and New England Districts.

USACE is conducting the MMRP RI at the Iona Island Naval Ammunition Depot FUDS under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and in accordance with (IAW) Engineer Regulation (ER) 200-3-1, FUDS Program Policy (USACE, 2004a). USACE conducts munitions response actions at FUDS under the provisions of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and Executive Orders 12580 and 13016, and the safety requirements of the Department of Defense (DoD) Explosives Safety Board (DDESB). By legal definition, the following is encompassed in the MMRP: unexploded ordnance (UXO) and discarded military munitions, together referred to as munitions and explosives of concern (MEC). Munitions constituents (MC) are considered MEC when found at concentrations high enough to present an explosive hazard (USACE 2005). The purpose of the MMRP RI is to determine whether further response action pursuant to CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is warranted at the Iona Island Naval Ammunition Depot FUDS for MEC. The primary objective of the MMRP RI is to characterize the nature and extent of MEC attributable to past DoD activities, and to assess potential explosive hazard risk to human receptors.

The Iona Island Naval Ammunition Depot FUDS consists of approximately 124 acres of land and inland water. The Navy used the site as an Ammunition Depot from 1900 to 1947. Activities included preparing, assembling, maintaining, inspecting, testing, and issuing ammunition; however, there was no manufacturing conducted on site. Iona Island Naval Ammunition Depot was deactivated in 1947. The former depot was excessed by the Navy in 1957 and transferred to the General Services Administration (GSA). GSA conveyed the FUDS property to Palisades Interstate Park Commission (PIPC) in 1965. PIPC currently utilizes a portion of Iona Island as a storage facility; however, the property is closed to the public and use is restricted to park purposes only. The FUDS property is part of the much larger Hudson River National Estuarine Research Reserve, a Significant Coastal Fish and Wildlife Habitat Area and National Natural Landmark.

[1] EA Engineering, P.C. is affiliated with EA Engineering, Science, and Technology, Inc., PBC who does business as EA Science and Technology in State of New York.

There are three FUDS projects for the Former Iona Island Naval Ammunition Depot:

- C02NY074401 Containerized (CON) HTRW project, which include response actions at an area of an eligible FUDS property to address:

    - Underground storage tanks (USTs), aboveground storage tanks (ASTs), transformers, hydraulic systems, investigative-derived waste (IDW), abandoned inactive monitoring wells, etc. Response actions for drums containing hazardous substances, pollutants, and contaminants are performed under the HTRW project category.

    - Incidental removal of contaminated soil resulting from a leaking UST or other container.

    - Long-term corrective actions required by Resource Conservation and Recovery Act (RCRA) Subtitle I, involving significant soil and groundwater response actions following UST closure/removal actions.

- C02NY074402 HTRW project, which includes environmental response actions at an area of an eligible FUDS property as the result of DoD activities related to hazardous substances, pollutants, and contaminants as defined in CERCLA; petroleum, oil, or lubricants (POL); DoD-unique materials; hazardous wastes or hazardous waste constituents; low-level radioactive materials or low-level radioactive wastes and explosive compounds released to soil, surface water, sediments, or groundwater as a result of DoD activities.

- C02NY074403 Military Munitions Response Program (MMRP) project, which include response actions at an area of an eligible FUDS property related to military MEC and their MC as the result of DoD activities at FUDS.

This UFP-QAPP was prepared for the MMRP project. The FUDS CON/HTRW project was closed out in 2012. The HTRW project, which includes the investigation of 19 HTRW Areas of Concern (AOCs) is being addressed under a separate RI with a separate UFP-QAPP. The FUDS-eligible AOCs are the locations/footprints of former buildings/structures where various contaminants of potential concern (COPCs) resulting from historical site activities have been detected or may be present. While the HTRW and MMRP RIs are being conducted as separate investigations with separate UFP-QAPPs, the investigations will be implemented concurrently and results from each investigation will be used to supplement the findings of each RI. For example, while the MMRP RI includes the investigation of MEC to evaluate explosive risk to human receptors, d u

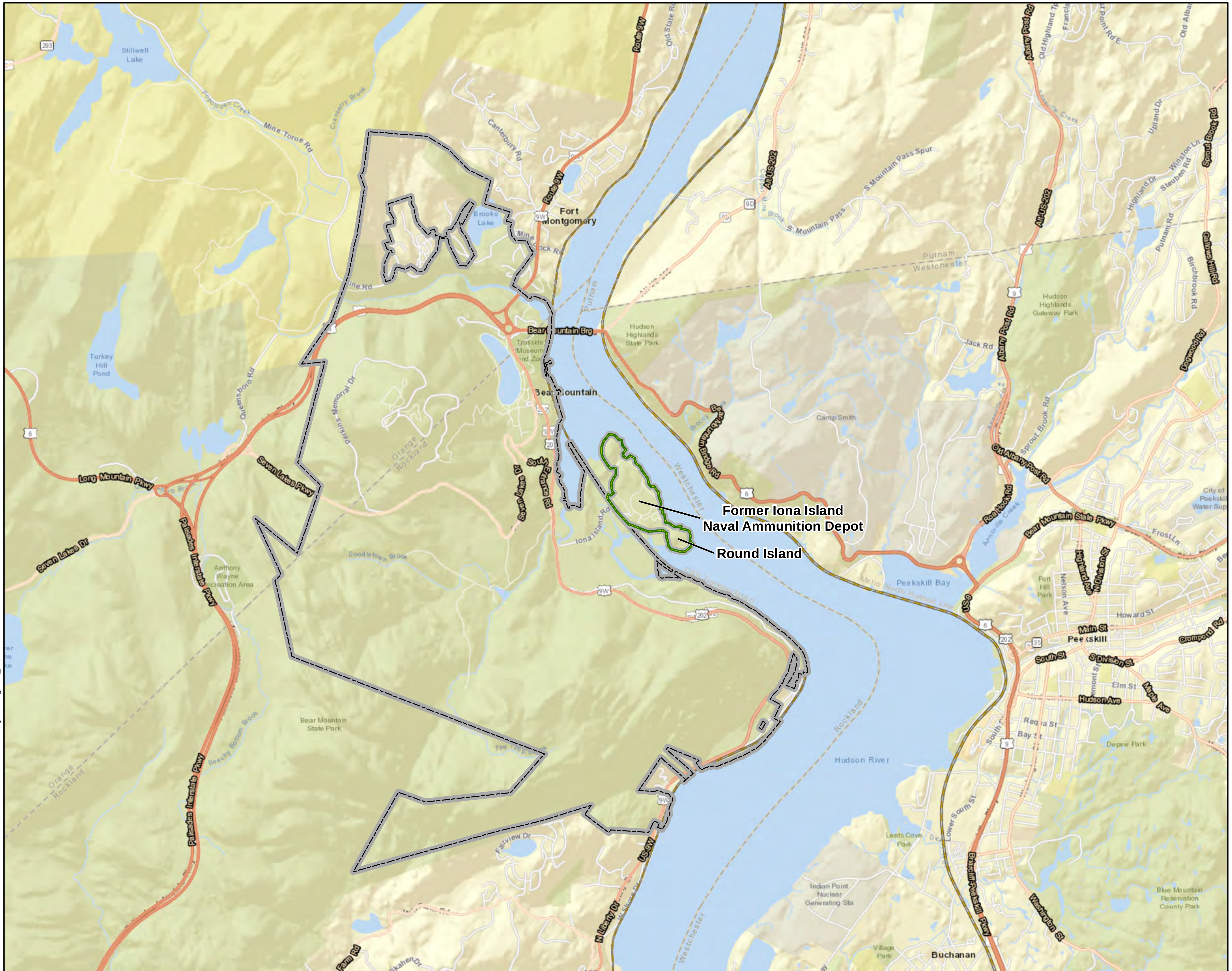
Historical records for the Iona Island Naval Ammunition Depot FUDS include several reports of ordnance items found within the FUDS and the potential for MEC to be found within the FUDS. An explosion in 1903, originating from the approximate center of the depot, is thought to have thrown stored ammunition shells as far as 1,250 feet (ft) from the blast. Anecdotal evidence identifies the potential for MEC around the former loading docks, where munitions may have been intentionally dumped or accidentally dropped into the Hudson River during the loading and unloading of supply vessels. Additionally, several potential MEC items have been reportedly sighted in low-tide conditions in an area of Round Island referred to as a “dump site” (Alion 2008). Four general areas at The Iona Island Naval Ammunition Depot FUDS have been identified as requiring investigation for MEC, including: (1) MRS-01 1903 Explosion Area, (2) former loading docks, (3) shoreline at and in the vicinity of the loading docks, and (4) a previously identified dump site. The former loading docks, the shoreline at, upstream, and downstream of the loading docks, and the previously identified dump site have not been assigned MRS numbers. Land, marsh, fill, and river environments are all present and require an investigation for MEC.

A review of additional former buildings was conducted during preparation of the HTRW UFP-QAPP at the request of the USACE to identify locations where filling or possible spilling of explosive-containing materials could have occurred. Seven former explosive storage and filling operations buildings were identified as having significant potential for explosive hazard based on limited information available in previous reports and input from USACE. These former buildings have not been previously investigated, and the presence of explosives in environmental media related to these buildings is unknown. Although these former buildings are not currently included in the FUDs projects at the Iona Island Naval Ammunition Depot FUDS and were not scoped in the existing contract, they are being considered for evaluation under the HTRW RI pending direction of contracting officer. Soil sampling for MC (explosives only) within the footprints these seven former buildings is outlined in the HTRW UFP-QAPP.

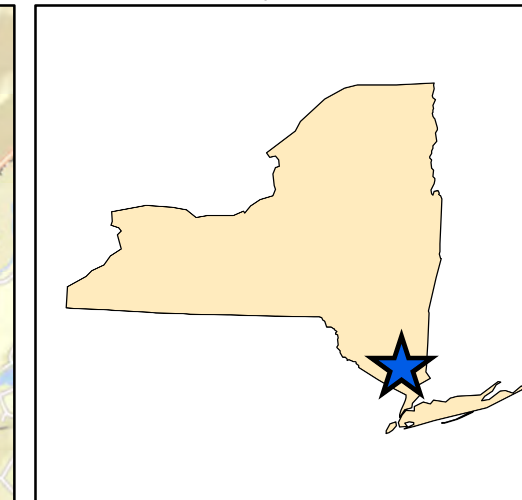
Current and future human receptors for the site include trespassers, construction workers, recreational users, and park employees/researchers. Human exposure to MEC can occur via direct contact of MEC at the surface, or through subsurface contact via excavation during construction activities. During the RI, geophysical surveys and intrusive investigations will be conducted to identify MEC or other potentially explosive/hazardous items and determine the horizontal and vertical extent of such contamination. If the RI concludes that the explosive risk associated with MEC is acceptable, then an NFA will be recommended for MEC at the Iona Island Naval Ammunition Depot FUDS. If the hazard for MEC is determined to be unacceptable, a Feasibility Study (FS) will be recommended to evaluate potential remedial alternatives. These remedial alternatives will be developed, screened, and analyzed to identify the most appropriate response action for MEC at the site. (Note: Potential human receptors may be exposed the explosive hazard of MEC and MC present at concentrations high enough to present an explosive hazard). The explosive risk associated with potential MEC and MC to ecological receptors is not evaluated; only the exposure risk from associated MC (metals and explosives). MC sampling and the exposure risk to human health and ecological receptors associated with explosives and metals MC in environmental media attributed to former DoD usage is being evaluated as a part of the HTRW investigation and is discussed in the HTRW UFP-QAPP. Details associated with the human health risk assessment can be found in the Human Health Risk Assessment Work Plan presented in Appendix D of the HTRW QAPP. Details associated with the ecological risk assessment can be found in the Ecological Risk Assessment Work Plan presented in Appendix E of the HTRW QAPP.)

This MMRP UFP-QAPP documents the project organization, roles, and responsibilities; specific investigative procedures, data collection activities; quality assurance (QA), and quality control (QC); and the assessment of oversight planning that will help ensure the quality of the investigation for the MMRP activities. The purpose of this UFP-QAPP is to provide instruction and guidance associated with the collection, analysis, and reporting of data to ensure collected data are scientifically valid, meet the established QC objectives, are legally defensible, and support project objectives.

This MMRP UFP-QAPP meets the requirements and elements set forth in the Intergovernmental Data Quality Task Force UFP for QAPPs (United States Environmental Protection Agency [EPA] 2005). The UFP-QAPP Manual integrates the EPA 7-step Data Quality Objective (DQO) process (EPA 2006), and the terminology in this UFP-QAPP is consistent with the UFP-QAPP Manual (EPA 2005). The worksheets in this document follow the Optimized UFP-QAPP format of Revision 1 of the UFP-QAPP Workbook (EPA 2012) as outlined in the crosswalk in Table 2. References used in preparation of the MMRP UFP-QAPP worksheets are presented in Worksheet #13 and at the end of this UFP-QAPP. Additionally, the MMRP UFP-QAPP follows the guidance provided in the AGC QAPP template. This UFP-QAPP (*preliminary draft version*) was reviewed by the PDT, which consisted of appropriate technical personnel. Review comments from the PDT were incorporated into the UFP-QAPP prior to it being reviewed (*draft version*) by the Independent Technical Review (ITR) team (i.e., EMCX).



VICINITY MAP



Legend

- FUDS Boundary
- Bear Mountain State Park Boundary

0 0.5 1
Miles
1 in = 1 miles

N

FIGURE 1
General Location of the
Iona Island Naval
Ammunition Depot **FUDS**
UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN
HAZARDOUS TOXIC AND RADIOACTIVE WASTE
REMEDIAL INVESTIGATION

Aerial: ESRI ArcGIS Online Map Service

Map Date: 1/2/2019

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Table 1 – Crosswalk between MMRP and HTRW UFP-QAPPs

Activity	Task	Applicable QAPP	Connection	Anticipated Schedule
Meetings	Technical Project Planning (TPP).	HTRW-QAPP MMRP-QAPP	Systematic planning process for MMRP and HTRW	• Meeting #1-Held November 7, 2018. • Meeting #2-Present MMRP DGM and HTRW (Phase 1) Field Effort #1 results. • Meeting #3-Present MMRP AGC and HTRW (Phase II) Field Effort #2 results. • Meeting #4-Present MMRP intrusive investigation and any follow-on HTRW results.
MMRP Investigation	Digital geophysical mapping (DGM) survey of accessible and near-shore areas.	MMRP-QAPP	Work will be performed in conjunction with HTRW field activities.	• MMRP Field Effort #1 – Spring 2020. • Activities performed in conjunction with the HTRW Field Effort #1 (soil sampling). • Avoid least bittern nesting season in the marsh in mid-April to mid-July
	Advance Geophysical Classification (AGC).			• MMRP Field Effort #2 – Spring 2020 • Avoid least bittern nesting season in the marsh in mid-April to mid-July
	Intrusive investigations of dig list. Mag and Dig of area not suitable for DGM. Underwater operations at former docks.			• MMRP Field Effort #3 – Late Summer 2020. • Avoid least bittern nesting season in the marsh in mid-April to mid-July. • Work will be performed in conjunction with HTRW Field Effort #2 (sediment sampling, if needed).
	MEC Risk Assessment performed in accordance with the guidance document "Trial Period for Risk Management Methodology at FUDS MMRP Projects."		Work will be conducted during the RI Reporting	• After completion of data collection.

<table>
<tr><th>Activity</th><th>Task</th><th>Applicable QAPP</th><th>Connection</th><th>Anticipated Schedule</th></tr>
<tr><td rowspan="2">HTRW Investigation</td><td>Groundwater and IS for site-related constituents in soil including metals and explosives. Shoreline Reconnaissance Survey.</td><td rowspan="2">HTRW-QAPP</td><td rowspan="2">Work will be performed in conjunction with MMRP field activities</td><td>• HTRW Phase I investigation– Spring 2020.
• Work will be performed in conjunction with MMRP Field Effort #1 (DGM survey).</td></tr>
<tr><td>Sediment sampling (if necessary) for constituents of potential concern.</td><td>• HTRW Phase II investigation – Summer 2020.
• Work will be performed in conjunction with MMRP Field Effort #3 (Intrusive Investigation of Selected AGC Anomalies)</td></tr>
</table>

Table 2 Crosswalk: UFP-QAPP Workbook to 2016-G-05 QAPP

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
1 and 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 and 5	Project Organization and QAPP Distribution	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule
4, 7, and 8	Personnel Qualifications and Sign-Off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements for Evaluating Existing Data
14 and 16	Project Tasks and Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory Specific Detection/Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 and 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Quality Control	2.3.5	Quality Control Requirements
21	Field Standard Operating Procedures	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical Standard Operating Procedures	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 and 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation

Optimized UFP-QAPP Worksheets		**2106-G-05 QAPP Guidance Section**	
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32, and 33	Assessments and Corrective Action	2.4	Assessments and Data Review (Check)
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35A	Data Verification Procedures (MEC Investigation)	2.5.1	Data Verification and Validation Targets and Methods
35B	Data Verification Procedures (MC Investigation)		
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37A	Data Usability Assessment (MEC Investigation)	2.5.2 2.5.3 2.5.4	Quantitative and Qualitative Evaluations of Usability Potential Limitations on Data Interpretation Reconciliation with Project Requirements
37B	Data Usability Assessment (MC Investigation)		

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

Site Location	Iona Island Naval Ammunition Depot FUDS, Stony Point, Rockland County, New York	
Contract/Work Assignment	W912DR-15-D-0014, Delivery Order #W912DR18F0587	
Contract Title	Iona Island FUDS MMRP and IRP*– Remedial Investigation through Decision Document	
Document Title	UFP-QAPP MMRP Remedial Investigation, Iona Island Naval Ammunition Depot FUDS, Stony Point, Rockland County, New York	
Lead Organization Project Manager (PM)	Erin Kirby, PG, LEP USACE–New England District	
Signature:	*Field Copy to be Signed*	**Date:**
Lead Organization Technical Manager	Todd Beckwith USACE – Baltimore District	
Signature:	*Field Copy to be Signed*	**Date:**
Lead Organization Quality Assurance Geophysicist	David King USACE – Baltimore District	
Signature:	*Field Copy to be Signed*	**Date:**
Investigative Organization PM	Timothy Reese, P.E. EA Engineering, P.C. and Its Affiliate – EA Science, and Technology	
Signature:	*Field Copy to be Signed*	**Date:**
Regulatory Agency Regional PM Printed Name/Title Signature/Date	Steven Scharf, P.E. New York State Department of Environmental Conservation (NYSDEC)	
Signature:	*Field Copy to be Signed*	**Date:**
Stakeholder PM Printed Name/Title Signature/Date	Edwin McGowan, Ph.D. Palisades Interstate Park Commission (PIPC)	
Signature:	*Field Copy to be Signed*	**Date:**

*Installation Restoration Program (IRP) has been changed to HTRW throughout the document per the Project Delivery Team (PDT) request.

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QAPP Worksheet #3 and #5: Project Organization and QAPP Distribution

This worksheet identifies key project personnel, as well as lines-of-authority and lines-of-communication among the lead organization, prime contractor, subcontractors, and regulatory agencies. The final UFP-QAPP and any changes/revisions will be provided to UFP-QAPP recipients identified with an asterisk in Figure 3-1 and in Table 3-1. Contractors and subcontractors shown on this chart are responsible for document control within their organizations. The UFP-QAPP will be made available to personnel presented in the project organizational chart (Figure 3-1).

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Figure 3-1
Project Organizational Chart

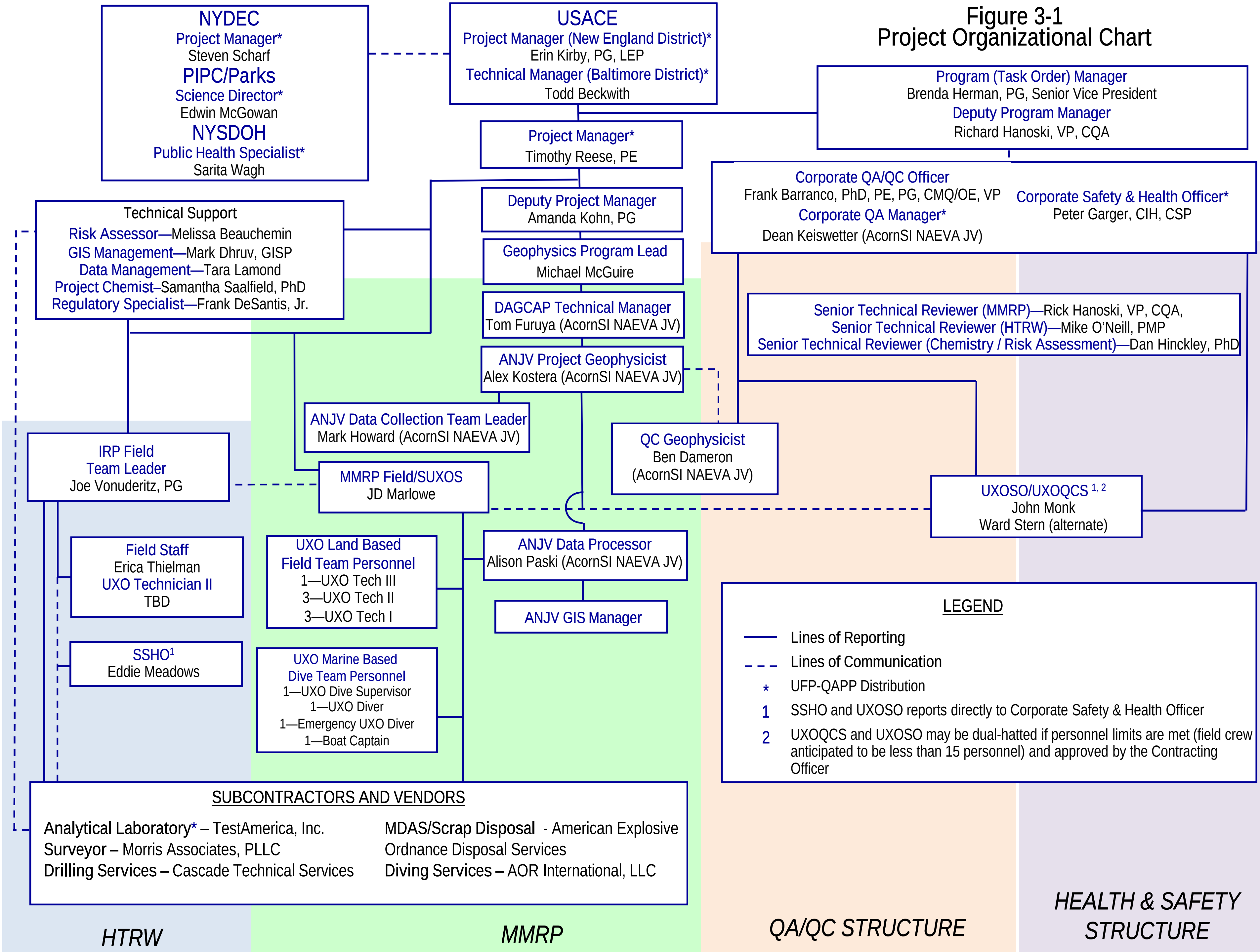

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TABLE 3-1 RESPONSIBLE UFP-QAPP RECIPIENTS

Name	Title	Organization	Telephone Number	Email Address
Erin Kirby	Project Manager	USACE – New England District	978-318-8147	erin.kirby@usace.army.mil
Todd Beckwith	Technical Manager	USACE – Baltimore District	410-962-6784	todd.t.beckwith@usace.army.mil
Steven Scharf	Project Manager	NYSDEC	518-402-9620	steven.scharf@dec.ny.gov
Edwin McGowan	Science Director	PIPC/Bear Mountain State Park	845-786-2701	edwin.mcgowan@parks.ny.gov
Timothy Reese	Project Manager	EA	410-329-5198	treese@eaest.com
Dean Keiswetter	Corporate QA Manager	Acorn SI-NAEVA Joint Venture (ANJV)	703-652-6239	dkeiswetter@acornsi.com
Peter Garger	Corporate S&H Manager	EA	410-527-2425	pgarger@eaest.com

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QAPP Worksheets #4, #7, and #8: Personnel Qualifications and Sign-off Sheet

This worksheet identifies key project personnel for each organization performing tasks defined in this UFP-QAPP and summarizes their title or role, qualifications (e.g., training and experience), any specialized training, licenses, certifications, or clearances required by the project. The qualifications of USACE personnel are under the purview of the DoD and will not be outlined in this UFP-QAPP. In addition, federal and state stakeholders' qualifications are under the purview of their respective agencies and will not be presented in this UFP-QAPP. The table in this worksheet summarizes the responsibilities and provides a space for the signatures of key personnel to the site covered in this UFP-QAPP. Signatures on the sign-off sheet indicate personnel have read, and agree to implement this UFP-QAPP, as written. Certification and training records for identified personnel are maintained by the organization's human resources department and are available on request.

Organization: Contractor - EA

Name	Project Title/Role	Education/Experience	Specialized Training	Licenses/ Certifications	Signature/Date
Brenda Herman, Professional Geologist (PG)	Program Manager	**Undergraduate Course Work** • Bachelor of Science (B.S.); Biology; University of Delaware; 1984 **Graduate Course Work** • Master of Science (M.S.); Geology; University of Delaware; 1989 Ms. Herman has 29 years of experience managing and conducting environmental projects for the DoD. Ms. Herman has been the Program Manager for several Indefinite Delivery/Indefinite Quantity contracts with USACE–Baltimore, Norfolk, and Omaha districts, as well as Aberdeen Proving Ground and Fort Belvoir. These contracts have covered hazardous, toxic, and radiological waste and MMRP investigation and removals; natural resources; compliance; and technology services.	• Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Responses (HAZWOPER) • USACE Construction Quality Management for Contractors • EA Project Management Training • Wharton Class, Essentials of Management	• P.G.—Tennessee; (No. 4671)	*Field Copy to be Signed*
Richard Hanoski	Deputy Program Manager	**Undergraduate Course Work** • B.S.; Psychology; University of La Vern; 1986 **Graduate Degree** • Master of Public Administration/Management Information Systems/1994 (Troy State University) Mr. Hanoski is a Certified Quality Auditor (CQA) and Master Explosives Ordnance Disposal (EOD) Technician with 40 years of experience and is responsible for managing EA's national Munitions Response Services. He reviews and provides the technical direction, including performance and technical oversight of munitions response operations and associated activities (digital geophysics, logistics, explosives management. He is responsible for all aspects of EA's Munitions Response Services and Environmental Remediation divisions nationally and internationally.	• OSHA 40-Hour Training • OSHA 8-Hour HAZWOPER Supervisor Training • OSHA 8-Hour HAZWOPER Refresher • USACE unexploded ordnance (UXO) Technician (No. 0139) • EA Project Management Training • USACE/Naval Facilities Engineering Command Quality Control Certification	• CQA, American Society for Quality • Master EOD Technician	*Field Copy to be Signed*
Timothy Reese, Professional Engineer (PE)	Project Manager (PM)	**Undergraduate Course Work** • B.S; Civil Engineering; Syracuse University; 1989 Mr. Reese has 24 years of PM experience, including 20 years at munitions sites and has managed MMRP and HTRW projects at 100+ DoD facilities nationwide for the U.S. Army, Air Force, and U.S. Environmental Protection Agency (EPA). He has performed and managed complex environmental, construction and MEC projects. He has successfully completed environmental and munitions projects under various federal regulations including: MMRP, CERCLA, SARA, NCP, and Toxic Substances Control (TSCA), as well as guidance provided by the DoD, U.S. Army, USACE, Navy, Air Force, EPA, and state regulators (including the NYSDEC). Over the past 10 years, he has managed 25 MEC task orders at the field operation level at 80+ current and former installations and FUDS under MMRP, Base Realignment and Closure, and Installation Restoration Program (IRP) including five RI/FS involving DGM mapping, MC sampling, surface/subsurface MEC investigations, MEC and munitions debris (MD) clearance, and removal actions.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour HAZWOPER Refresher; annually • OSHA 8-Hour Hazardous Waste Operations Supervisor Training • Construction Quality Management for Contractors, USACE • Geosynthetic Research Institute – Designing with Geosynthetics for Landfill Design, Drexel University • Hazardous Waste/Material Operations Training Course • U.S. Department of Transportation Regulation Training • IATA Training in the Shipment of Dangerous Goods • Visual Sample Plan Training • Cardiopulmonary resuscitation (CPR) and First Aid Training; Biannually	• P.E.—New Jersey (No. 39951)	*Field Copy to be Signed*

Name	Project Title/Role	Education/Experience	Specialized Training	Licenses/ Certifications	Signature/Date
Amanda Kohn, PG	Deputy PM	**Undergraduate Course Work** • B.S., State University of New York at Cortland; Geology; 2004 Ms. Kohn is a P.G. with 11 years of experience in EA's Site Characterization and Remediation Group. She is experienced in the CERCLA process from the Preliminary Assessment (PA)/Site Investigation (SI) through Remedial Action stage. She is currently serving as the PM for three EPA Superfund Sites and one NYSDEC Superfund Site. In addition, she has served as the Deputy PM, Task Manager, and Field Team Lead for multiple projects under DoD, EPA, and NYSDEC contracts. Her responsibilities have included tracking and managing budgets and schedules, serving as a point-of-contact with clients, preparing planning documents, coordinating field investigations, overseeing project execution, completing data analysis, and developing and reviewing technical reports.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour HAZWOPER Refresher; Annually • OSHA 8-Hour Health and Safety Supervisor Training; Current • CPR and First Aid Training; Biannually • Project Management Training	• P.G.–Pennsylvania (No. 005105) • P.G.–New York (No. 000115)	*Field Copy to be Signed*
Michael McGuire	Geophysics Program Lead	**Undergraduate Course Work** • B.S.; Geophysical Engineering; Colorado School of Mines; 1981 Mr. McGuire serves as a Senior Geophysicist in the Munitions Response Group and provides technical support on MMRP projects. He has more than 31 years of experience as a geophysicist including project management, data collection, processing, interpretation, and mapping of seismic reflection and refraction data, time and frequency domain electromagnetic (EM) data, magnetic data, ground penetrating radar data, resistivity data, and borehole geophysics. He has extensive experience related to the detection and mapping of UXO.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour HAZWOPER Refresher; Annually • OSHA 8-Hour Health and Safety Supervisor Training; Current • Amoco 720-Hour Geologic and Geophysical Training • Project Management, Supervision, Public Speaking, Department of Transportation; Tetra Tech, Inc. • ESTCP/NAOC UXAnalyze Advanced Classification Course • U.S. Army Engineering Support Center Huntsville Oasis Montaj UXAnalyze • Pacific Northwest National Laboratories (PNNL) Visual Sample Plan (VSP) for MEC Investigations Course • CPR and First Aid Training; Biannually		*Field Copy to be Signed*
Dan Hinckley, Doctor of Philosophy (Ph.D.)	Senior Technical Reviewer	**Undergraduate Course Work** • B.S.; Chemistry; Wright State University, Dayton, OH; 1983 **Graduate Course Work** • M.S.; Environmental Chemistry, Physical Chemistry; Wright State University, Dayton, OH; 1985 • Ph.D.; Marine Chemistry, Chemical Oceanography; University of South Carolina, Columbia, SC; 1989 Dr. Hinckley has 36 years of multi-disciplinary experience in environmental chemistry, marine chemistry, analytical chemistry, physical chemistry, human health and ecological risk assessment, environmental assessment, and project management. He specializes in human health and ecological risk assessments, environmental fate and transport assessment, environmental characterization, sample design, evaluations of soil, water, and sediment quality and quality assurance (QA)/quality control (QC) issues. He has participated in more than 300 human health and ecological risk assessments performed for sites from Egypt to Guam and has worked with risk assessors in more than a dozen states and most EPA regions. He has performed Senior Technical Reviews and external reviews for many risk assessments, including those associated with EPA Regions 3 and 6, and the State of Delaware.	• DoD Environmental Monitoring and Data Quality Workshop • EA Project Management Training • Expert Witness Workshop		*Field Copy to be Signed*

Name	Project Title/Role	Education/Experience	Specialized Training	Licenses/ Certifications	Signature/Date
Samantha Saalfield, Ph.D.	Project Chemist	**Undergraduate Course Work** • Bachelor of Arts (B.A.); Geology/Chemistry; Whitman College; 2004 **Graduate Course Work** • Ph.D.; Earth Sciences; Dartmouth College; 2009 Dr. Saalfield has more than 13 years of experience in site characterization and remediation, including inorganic geochemistry, contaminant fate and transport, groundwater modeling, geochemical analysis, and data quality planning and analysis. She specializes in the behavior of inorganic contaminants in surface and groundwater. She also has experience with data quality planning and analysis, assessments of remedial alternatives, and geochemical and hydrogeological modeling.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour HAZWOPER Refresher; Annually • Confined Space Training • INNOV-X Systems Radiation Safety and Operations Training for Field X-ray fluorescence analyzers • Interstate Technology and Regulatory Council's Incremental Sampling Methodology Training • DoD Quality Systems Manual v.5 Training • EA Project Management Training • CPR and First Aid Training; Biannually		*Field Copy to be Signed*
Frank DeSantis, Jr.	Regulatory Specialist	**Undergraduate Course Work** • B.S.; Environmental and Forest Biology; State University of New York College of Environmental Science and Forestry; 2000 Mr. DeSantis has over 14 years of experience in the biological and environmental fields, including Phase I and Phase II assessments in support of the Army Operational Range Assessment Program, remedial action–operation and long-term management activities in support of the U.S. Air Force and Army Environmental Command environmental programs; site characterizations and pre-design investigations in support of U.S. Air Force performance-based remediation programs; and RIs and FSs and remedial design for the NYSDEC. He has provided project management for preliminary site assessments, site characterizations, RI/FS, and remedial design/remedial actions. He served as the investigation manager for an RI/FS of a metals-impacted tidal marsh at Camp Smith, New York. He understands the New York guidance (e.g., Division of Environmental Remediation [DER]-10: Technical Guidance for SI and Remediation) and promulgated remedial regulations (e.g., Title 6, New York Codes Rules and Regulations, Part 375, Soil Clean-up Objectives) at sites with metal contaminants showing migration via surface water and sediment deposition.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour HAZWOPER Refresher; Annually • OSHA 8-Hour Hazardous Waste Operations Supervisor Training • 30-hour Construction Safety and Health • Permit Required Confined Space Training • Safe-Capture: Chemical Immobilization of Wildlife • CPR and First Aid Training; Biannually		*Field Copy to be Signed*
Michael O'Neill, PMP	Senior Technical Reviewer	**Undergraduate Course Work** • B.S.; Engineering Science; Loyola College; 1990 Mr. O'Neill is a PM with 27 years of experience in every facet of the CERCLA process. He has 23 years of experience successfully completing environmental IRP and MMRP projects under Federal regulations (CERCLA, Resource Conservation and Recovery Act (RCRA), SARA, TSCA and knowledgeable in DoD and U.S. Army guidance. He has been involved in many phases of site assessments (Phase I and Phase II site assessments, environmental baseline surveys and engineering FSs), and RIs beginning with development of the scope of work and preparation of the field sampling plan, preparation of health and safety plans, site and subcontractor management, site research, sampling and sample custody, as well as report preparation, remedial design, project costing and oversight during remedial action. He has experience managing various size tasks and projects.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour Hazardous Waste Operations Supervisor Training • Asbestos Inspector • Lead Inspector (EPA Agency Model Curriculum) • MARSSIM Radiological Survey Design Course • Introductory Health Risk Communications Workshop • Construction Quality Management for Contractors • EA Project Management Training • UXO Safety Training Program • Anti-Terrorism Level I Training • CPR and First Aid Training; Biannually	• Project Management Institute (No. 1273776)	*Field Copy to be Signed*
Frank Barranco, Ph.D., PG., P.E.	Corporate QC Manager	**Undergraduate Course Work** • B.A., Geology; Duke University; 1984 **Graduate Course Work** • M.S.; Geology; University of Texas Arlington; 1988 • Ph.D., Environmental Science and Engineering; Colorado School of Mines; 1998 Dr. Barranco has more than 25 years of experience in the development and implementation of QA/QC systems. As the Director of QC for EA's Quality Management Program, Dr. Barranco authors, and implements company-wide QA/QC policies, guidance documents, and standard operating procedures (SOPs). In this role, Dr. Barranco is heavily involved in the quality monitoring associated with QC systems across EA, including the Senior Technical Review Program, Project and Program Reviews, and oversight of the Technical Chiefs. In addition to this company-wide role, Dr. Barranco serves as QA Officer on individual programs and large Indefinite Delivery/Indefinite Quantity contracts across EA.	• OSHA 40-Hour HAZWOPER Training • OSHA 8-Hour Hazardous Waste Operations Supervisor Training • CPR and First Aid Training; Biannually	• P.G.–Tennessee (No. 005603) • P.E. –Maryland (No. 43120) • Certified Manager of Quality/ Operational Excellence (No. 53424)	*Field Copy to be Signed*

Name	Project Title/Role	Education/Experience	Specialized Training	Licenses/ Certifications	Signature/Date
Peter Garger, Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP)	CIH	**Undergraduate Course Work** • B.A. Chemistry, Hofstra University; 1978 **Graduate Course Work** • M.S. Environmental Health Science, Sc. M. Hygiene and Public Health, Johns Hopkins University; 1981 Mr. Garger is a CIH and CSP with over 38 years of experience. He oversees health and safety activities for EA, including all health and safety activities in support of multiple Army, United States Air Force, Navy, and EPA contracts. Maintains EA's Corporate Health and Safety Program Manual, coordinates safety-training activities, and develops and maintains medical surveillance programs. He has 30+ years of experience managing, and conducting industrial hygiene services, including oversight of environmental remediation projects. Manages OSHA reporting requirements.	• OSHA Construction Outreach Trainer for 10- and 30-hour Construction Safety Training • OSHA 10-Hour Supervisor Training • Department of Transportation Hazardous Materials Training • USACE – UXO Training • HAZWOPER 40-hour Training, 8-hour Supervisor Training, and 8-hour refresher • CPR and First Aid Certified • Investigating and Mitigating Microbial Contamination in Buildings • National Institute for Occupational Safety and Health 582 Microscopic Evaluation of Fibers • Asbestos Building Inspector/Management Planner • X-Ray Fluorescence Testing Operator – Lead Paint Analysis • Drug and Alcohol Awareness for Supervisors Training; All One Health	• CSP– (No. 20560) CIH–American Board of Industrial Hygiene (No. 3118)	*Field Copy to be Signed*
John "JD" Marlowe	Senior Unexploded Ordnance Supervisor (SUXOS)	**Education** • Graduate of Naval EOD School; Indian Head, Maryland; 1995 Mr. Marlowe has 39 years of experience in all phases of munitions response actions and applicable safety standards, including supporting DoD installation operations and IRP remedial investigations. He has extensive EOD/ UXO experience in all phases of munitions response actions, including SUXOS experience on MMRP action projects for the DoD. He is experienced in performing and supervising MEC projects and has extensive "hands-on" training to include all aspects of safety; extensive project and technical management, field operations and crew leadership; and expertise in MEC/UXO identification and recovery. Has 18 years of QA/QC experience in supervisory EOD/UXO positions overseeing project health and safety matters, including oversight and interface for onsite subcontractors; implementing safety meetings, visitor orientations, inspections, training, audits, and self-assessments; providing site-specific MEC awareness training; coordination with range control and adherence to installation procedures; and maintaining written safety and equipment logs/records on DoD project across the United States. Mr. Marlowe is experienced in complying with CERCLA/RCRA; DoD; EPA Region 3, and NCP regulations. His munitions experience includes, projects related to improvised explosive devices, small arms ammunition, general purpose bombs, cluster bombs, pyrotechnics, artillery projectiles, rockets, missiles, and incendiary and chemical bombs.	• OSHA 40-Hour HAZWOPER • OSHA 8-Hour HAZWOPER Refresher; Annually • OSHA 8-Hour Hazardous Waste Operations Supervisor • OSHA 30-Hour Construction • OSHA 10-Hour Construction • Naval School, Explosive Ordnance Disposal Phase 2 (surface • Hazardous Material Safety (Canadian) • Transportation of Dangerous Goods (Canadian) • EOD/Improvised Explosive Device Course (Canadian) • DEODS NATO Officers/SNCO EOD (England) Course • EOD Specialty Course (Canadian) • EOD Basic Course (Canadian) • OSHA Annual Respirator Medical • Forestry-Granton Institute of Technology • Electronics-Saskatchewan Technical Institute • Level 1 Anti-Terrorism Training • NAVSEA Material Potentially Presenting an Explosive Hazard (MPPEH) Training • CPR and First Aid/AED Training; Biannually	• Master EOD Technician • Certified Heavy Equipment Operator • Range Safety Officer Certification (Canadian)	*Field Copy to be Signed*
John Monk	UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (QCS)	**Education** • Naval EOD Mr. Monk is a Senior UXO Technical Expert with over 36 years of experience in Naval EOD/diver and munitions and MEC projects. His primary responsibilities are as a UXOSO/QCSUXO UXOSO and team leader for munitions response related projects. His project work focuses primarily on location, removal/disposal, and clearance of conventional, chemical/biological/radiological munitions. He is also an expert in underwater ordnance and Naval underwater diving techniques for both nitrogen and mixed gas diving operations. He has experience with identifying and resolving safety and quality issues with respect to munitions related activities. He functions as a liaison with USACE and subcontractors' safety personnel and quality personnel; and experience with oversight of all aspects of explosive safety on various DoD projects.	• OSHA 40-hour HAZWOPER Training • OSHA 8-Hour Site Managers and Supervisors Training Course • OSHA 8-Hour HAZWOPER Refresher; Annually • OSHA 30-Hour Construction Safety Course • OSHA 8-Hour HAZWOPER Supervisor • EA Project Management Training • Niton X-Ray Fluorescence Training Course • Hazardous Waste Management and Shipping for Environmental Professionals • USACE Construction Quality Management for Contractors Course • Delaware Department of Natural Resources and Environmental Control Soil and Water Conservation (Blue Card) Course; 2005 • Competent Person Trenching and Excavation, West Virginia University • Fall Prevention and Protection Competent Person Training • Confined Space Course Certificate • Explosives Blasters License-MD #G-300 • CPR and First Aid; Biannually		*Field Copy to be Signed*

Name	Project Title/Role	Education/Experience	Specialized Training	Licenses/ Certifications	Signature/Date
Eddie Meadows	Site Health and Safety Officer	**Undergraduate Course Work** • B.S.; Environmental Sciences; Virginia Tech; 1995 Mr. Meadows has 22-year of experience in the successful completion of numerous projects and field efforts or phases of those projects, which include management; field oversight; health and safety officer; sample collection and sample custody of soil, water, sediment, and air matrixes; mobile laboratory testing; field screening; report writing, and data reduction/management; basic surveying; and remedial injection activities. He has served as Site Safety and Health Officer (SSHO) for several investigations, removal actions, groundwater monitoring well installations, and construction projects.	• OSHA 40-Hour HAZWOPER • OSHA 8-Hour Hazardous Waste Operations Supervisory Training • OSHA 30-Hour Construction Safety and Health Certification • Excavation Safety for Competent Person Training • Confined Space Training • USACE Construction Quality Management for Contractors • OSHA 24-Hour Fall Protection for Competent Person Training • Immunoassay Training for field screening of Polycyclic Aromatic Hydrocarbons, Polychlorinated Biphenyls, and Trinitrotoluene (TNT) • X-Ray Fluorescence Spectrum Analyzer Training • Basic Radiation Worker and Fundamentals of Radiation Training. • Respirator Fit Test		*Field Copy to be Signed*
Joe Von Uderitz, PG	Project Geologist	**Undergraduate Course Work** • B.S.; Environmental Studies and Geology; Alfred University; 2001 Mr. Von Uderitz is a PG with more than 12 years of experience in environmental site assessment and remediation. His primary responsibilities are oversight of field activities including preparing work plans, scheduling, and overseeing implementation of work plans. Oversight includes contractor QC responsibilities of the installation and operations of treatment systems, as well as installation of monitoring and recovery wells, and development, gauging, and sampling of wells. He maintains product recovery, dual phase extraction systems, and catalytic oxidizer systems at various locations. Additionally, he has experience with construction activities and associated safety and health concerns, site inspections to evaluate work conditions for potential job site hazards, ensuring proper selection and use of personal protective equipment, use of monitoring equipment, and safety and health compliance. Provides daily health and safety briefings for personnel on multiple construction sites. Provides technical review and assisted in preparation of safety procedures for Site Safety and Health Plans (SSHPs) and Accident Prevention Plans (APPs).	• OSHA HAZWOPER 40-hour Training and 8-hour refresher • OSHA 30-hour Construction Safety and Health Training • USACE Construction Quality Management for Contractors Worker • The Mine Safety and Health Administration Training • 40-hour Radiation Worker I Training • Excavation Safety Training (Trenching/Shoring) • Association of Reciprocal Safety Councils Training • CPR and First Aid Certified • Permit-Required Confined Space Entrant • Permit-Required Confined Space Attendant • Permit-Required Confined Space Supervisor • General Radiation Worker Training • CPR and First Aid Certified	• P.G.- Pennsylvania (No. 005197) • P.G.-New York (No. 000144)	*Field Copy to be Signed*

Organization: Subcontractor – Acorn SI-NAEVA Joint Venture (ANJV)

Name	Project Title/Role	Education/Experience	Specialized Training	Required Licenses/Certifications	Signature/Date
Dean Keiswetter	Corporate Quality Assurance Manager (QAM)/Project and DoD Advanced Geophysical Classification Accreditation Program QAM	Ph.D. Geophysics; M.B.A. M.S., Geophysics; B.S., Geology 23 years of digital data processing focusing on detection and classification of UXO and other buried objects.	• UX-Analyze Developer and Trainer		*Field Copy to be Signed*
Tom Furuya	DAGCAP Technical Manager	B.S./Geology and Physics 20-plus years of data processing experience; over 12 years' experience using advanced geophysical sensors, including data processing and detection/selection of target of interest (TOI) and non-TOI	• UX-Analyze Developer and Trainer		*Field Copy to be Signed*
Alexander Kostera	Project Geophysicist	B.S./Geology; 20 years experience at MMRP projects, including data collection and data analysis; 5 years experience using advanced geophysical sensors	• OSHA 40-hour HAZWOPER Training • OSHA 8-hour HAZWOPER Refresher	P.G. – Virginia (No. 1845)	*Field Copy to be Signed*
Alison Paski	Data Analyst	B.S./Geology; 18 years of data processing experience on MMRP projects; over 11 years' experience using advanced geophysical sensors, including data processing and detection/selection of TOI and non-TOI	• Oasis Montaj AGC Data Processing • UX-Analyze Course by ESTCP		*Field Copy to be Signed*
Ben Dameron	QC Geophysicist	B.S./Geophysics; 14 years of data processing experience on MMRP projects; 11 years' experience using advanced geophysical sensors	• OSHA 40-hour HAZWOPER Training • OSHA 8-hour HAZWOPER Refresher		*Field Copy to be Signed*
Mark Howard	Senior Geophysicist/AGC Data Collection Field Team Lead	B.S. Geology; 21 years' experience at MMRP projects, including data collection and data analysis; 10 years' experience using advanced geophysical sensors	• OSHA 40-hour HAZWOPER Training • OSHA 8-hour HAZWOPER Refresher • Oasis Montaj AGC Data Processing • UX-Analyze Course by ESTCP	P.G.-Pennsylvania (No. 3152)	*Field Copy to be Signed*

QAPP Worksheet #6: Communication Pathways

This worksheet documents specific issues (communication drivers) that will trigger the need for formal (documented) communication with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing notifications, obtaining approvals, and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, approvals to proceed from one DFW to the next, field changes, emergencies, non-conformances, and stop-work orders.

Communication Drivers	Responsible Entity	Name	Telephone Number	Procedure (Timing, Pathways, etc.)
Contractual modification and/or program performance	USACE KO	Kathryn Brown (Baltimore)	410-962-2585	Overall responsibility for overseeing and monitoring the contractor's performance and assures the contractor receives impartial, fair, and equitable treatment under the Delivery Order. Ultimately responsible for the final determination of the adequacy of the contractor's performance and authorized to obligate the Government on this Delivery Order.
Contractual modification and/or program performance	USACE Contracting Officer Representative (COR)	Sesh Lal (Baltimore)	410-962-2585	Contractual modification and/or program performance. Communicates directly with USACE PM and EA Program Manager/Deputy Program Manager.
PM with USACE	USACE Project Manager and USACE Technical Manager	Erin Kirby (New England) Todd Beckwith (Baltimore)	978-318-8147 410-962-6784	Together work as primary USACE POCs. Overall management of the project. Communicates with and gives direction to EA PM. Reviews and approves project plans and their modifications. Communicates with regulators and relays information to EA PM/Deputy PM.
POC with NYSDEC	NYSDEC	Steven M. Scharf	845-786-2701	Case Manager and primary POC for State of New York. Provides regulatory oversight. Communicates with USACE PM and/or PIPC Executive Director.
POC with PIPC/Bear Mountain State Park	PIPC Director of Science	Edwin McGowan	845-786-2701 x263	Primary POC for PIPC. Provides stakeholder oversight. Communicates with USACE PM and/or NYSDEC.
Contractual modification and/or program performance	EA Program Manager	Brenda Herman	410-527-2474	Communication with USACE at the Programmatic Level regarding overall performance. Acts as an advocate for USACE to ensure that project needs are met. Supports the PM/Deputy PM. Provides corporate commitment to allocate necessary resources.
Contractual modification and/or program performance	EA Senior Technical Reviewer, Deputy EA Program Manager	Richard Hanoski	443-632-4887	Communication with USACE at the Programmatic Level regarding overall performance. Acts as an advocate for USACE to ensure that project needs are met. Supports the EA PM/Deputy PM. Provides corporate commitment to allocate necessary resources.
Manage all project phases/overall technical lead	EA Project Manager	Timothy Reese	410-329-5198	Overall contractor management of the project. Maintains lines of communication between USACE and EA. Communicates with USACE POC regarding project direction as well as notification of any project issues. Ensures that project is on time and within budget. Ensures that project team maintains technical, quality, and safety and health standards. Leads communication with stakeholders. Manages subcontractors. Completes final review of all deliverables.
Contractor communication with USACE	EA Project Manager	Timothy Reese	410-329-5198	POC for all technical, QA, and administrative matters regarding the Contractor's implementation of the project (verbal, written or electronic).
Project support to EA PM/ Deputy PM	EA Senior Technical Reviewer	Michael O'Neill	410-329-5142	Senior Technical Reviewer for technical approach and documents. Communicates with the EA PM/Deputy PM.
Change to UFP-QAPP	EA Risk Assessor	Melissa Beauchemin	401-287-0380	Communicates with the EA PM/Deputy PM. Will notify EA PM of approval of minor change (verbal, written, or electronic); complete field change request for efficiency or changed conditions.
Change to UFP-QAPP	EA Project Chemist	Samantha Saalfield	410-584-7000 ext. 5215	Communicates with the EA PM/Deputy PM. Will notify EA PM of approval of minor change (verbal, written, or electronic); complete field change request for efficiency or changed conditions.
Change to UFP-QAPP	EA Project Manager	Timothy Reese	410-329-5198	For field change requests, the UFP-QAPP does not need to be revised, a field change request should be sent to the USACE PM for approval. USACE and NYSDEC approval is required if an addendum, amendment or revision to the UFP-QAPP is necessary.
Analytical data oversight/corrective action	EA Project Chemist	Samantha Saalfield	410-584-7000 ext. 5215	Oversees the laboratory analysis, as necessary, FUDSChem and data validation activities. Communicates directly with the laboratory's PM. Provides technical oversight of data evaluation and summary in RI Report.
Project completion and performance deficiencies	Corporate Quality Manager	Frank Barranco	410-329-5137	Monitors work, procedures, and documentation to ensure compliance with QC procedures and engineering practices. Develops and oversees implementation of a corrective action plan, if necessary. Reviews all aspects of project completion and stop work if deficiencies in the work are noted. Communicates with the EA PM/Deputy PM.

Communication Drivers	Responsible Entity	Name	Telephone Number	Procedure (Timing, Pathways, etc.)
Coordination of MEC field activities and oversight for project team to ensure compliance with documents	EA SUXOS	John "JD" Marlowe	443-632-4887 (cell)	Coordination of field activities and oversight for project team to ensure compliance with documents. Manages on land site operations. Reports to EA PM regarding issues with cost, schedule, etc. Ensures modifications meet USACE requirements and overall project quality objectives. Ensures compliance with approved project documents during execution of fieldwork. Prepares and submits SUXOS Daily Reports daily during land-based field activities.
Recovery of MEC/MPPEH	EA SUXOS	JD Marlowe	443-632-4887 (cell)	Notify USACE OESS (if on-site), EA PM/Deputy PM, and POC with PIPC / Bear Mountain State Park.
MEC QC - variance or deficiency	EA UXOSO/QCS	John Monk or Ward Stern (alternate)	717-887-5582 (cell) 256-731-9151 (cell)	Notify EA PM and QA Manager of variance or deficiency who will inform USACE PM and TM. Develop applicable documentation, corrective actions and communicate resolution to field personnel.
MEC technical support	EA Munitions Response National Service Line Manager	Richard Hanoski	443-632-4887	Provides technical support to EA project team for all munitions related projects.
Geophysical QC - variance or deficiency	Acorn SI/NAEVA Joint Venture / EA Quality Control Geophysicist Geophysics Program Lead	Ben Dameron / Michael McGuire	410-329-5147	Notify EA PM, Geophysics Program Lead, and QA Manager of variance or deficiency who will inform USACE PM and TM. Develop applicable documentation, corrective actions and communicate resolution to field personnel. Provides geophysical oversight during RI IAW the QASP.
Geophysical QA Concern (i.e., missed validation seed)	USACE-Baltimore	David King	410-962-2809	Contact EA's Geophysical Program Lead (Mike McGuire) within 24 hours following the identification of concern via phone, followed by an email.
Diving QC - variance or deficiency	EA UXOSO/QCS	John Monk	717-887-5582	Notify EA PM and QA Manager of variance or deficiency who will inform USACE PM and TM. Develop applicable documentation, corrective actions and communicate resolution to field personnel. Provides dive operations oversight during RI IAW the QASP.
Technical issues during implementation of the project	EA PM	Timothy Reese	410-329-5198	Will notify the USACE PM and TM of any significant technical or QC issues during the field investigation.
Safety Incident/Emergency in the field	EA UXOSO/QCS and SUXOS	John Monk JD Marlowe Ward Stern (Alternate)	717-887-5582 (cell) 443-752-1775 (cell) 256-731-9151 (cell)	Notify the EA PM/Deputy PM who will relay emergency to appropriate entities. Provides direction to field staff and subcontractors.
Stop Work Order	USACE COR or PM	Sesh Lal (Baltimore) Erin Kirby (New England)	410-630-2585 978-318-8147	COR or PM will contact EA's Program Manager and Project Manager, respectively of a Stop Work Order to the contract.
Mobilization and demobilization	EA Project Manager	Timothy Reese	410-329-5198	Communication with USACE PM and TM regarding timelines and access requirements. USACE PM and/or TM to relay information to other parties.
Coordination of sample bottle/sample receipt and analytical data processing	Laboratory PM	Darlene Bandy	303-736-0188	Coordination of sample bottles, confirmation of samples, issues at the laboratory, and data availability will be communicated to the Project Chemist and/or Data Manager.

QAPP Worksheet #9: Project Planning Session Summary

This worksheet is used to document project planning sessions and is used to provide a concise record of participants, key decisions or agreements reached, and action items. However, the TPP Meeting #1 summary and presentation materials are presented in Appendix A of this UFP-QAPP. If a planning session occurs after this UFP-QAPP has been finalized, and the session results in a change to this UFP-QAPP, the meeting summary and materials will be added to Appendix A.

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QAPP Worksheet #10: Conceptual Site Model

This worksheet presents available site information for the Iona Island Naval Ammunition Depot FUDS and the project's CSM as it relates to the proposed MMRP RI (MEC investigation).

As defined in EM 200-1-12 – *Conceptual Site Models*, a CSM describes sources of contamination, as well as complete, potentially complete, or incomplete exposure pathways; current, determined, or reasonably anticipated future use of property; and potential receptors (USACE 2012). The CSM is a working, iterative model of site conditions used to assist in the visualization and communication of available information and development of DQOs and the technical approach presented in this UFP-QAPP. Information obtained during implementation of the RI will be used to address data gaps, and update and refine the CSM in the MMRP RI Report.

SITE BACKGROUND

The Navy used the Iona Island Naval Ammunition Depot between 1900 and 1947, with the major effort consisting of assembling naval ammunition for World War II. Although no ammunition was manufactured at Iona, various types of explosives were assembled on site. Activities included preparing, assembling, maintaining, inspecting and testing ammunition; storing bulk explosives, ammunition and ordnance material; and issuing ammunition to the fleet, shore establishments, armed merchantmen, transport and district forces (U.S. Army Geospatial Center [AGC] 2018).

The Iona Island Naval Ammunition Depot FUDS is listed as a State Superfund Site (Site Code 334069) in the NYSDEC Environmental Site Remediation Database, related to the MMRP project at the site (NYSDEC 2017a). The NYSDEC site description indicates antimony, copper, and lead concentrations exceeding background and relevant ecological screening values in surface soil. Antimony, copper, lead, nickel, and zinc exceeded background concentrations and ecological screening values in sediments. Lead was listed as a COPC in surface soil for human health (NYSDEC 2017a).

SITE LOCATION

The Iona Island Naval Ammunition Depot FUDS property consists of approximately 124.2 total acres of land and inland water located on Iona Island and Round Island along the west side of the Hudson River, in the Town of Stony Point, Rockland County, New York (Figure 1). Iona Island is located within the Lower Hudson River Valley region, which includes all of Putnam, Rockland, and Westchester counties and is considered part of the downstate New York region due to its geographical and cultural proximity to New York City.

Iona Island is in Bear Mountain State Park on the east side of U.S. 202/Route 9W, 6 miles south/downstream of West Point Military Academy, one mile south/downstream of the Bear Mountain Bridge, and 41.2 miles north/upstream from the mouth of the Hudson River. Round Island, the southeastern part of Iona Island, was once cut off by marshes and was attached to Iona Island with fill in the early 20th century (NYSDEC and U.S. Department of Commerce 1992).

Iona Island is connected to the mainland by a narrow two-lane road off U.S. 202/Route 9W near Doodletown. The island is accessed by crossing active River Subdivision (CSX Transportation) railroad tracks and entering through an unmanned gate.

Figure 10-1 shows the Iona Island FUDS boundary, MRS-01 1903 Explosion Area, former dock areas and dump site.

SITE HISTORY

The following history of operational use was obtained from the Naval Ammunition Depot Iona Island FUDS, New York, Historical Photographic Analysis prepared by AGC in 2018.

Prior to use by the military, Iona Island was utilized as a resort hotel during the Civil War. There was no documented evidence available of past use of ordnance-related items on the island prior to use by the military. The Navy acquired Iona Island from the L.H. Mace Brokerage Company of New York City in 1899 for construction of the Iona Island Naval Ammunition Depot (USACE 1998). In 1942, an additional approximately 13 acres of marsh and Round Island, was purchased and used for ammunition storage (USACE 1998)[2].

In 1903, at least one 13-inch shell exploded between Shell Houses 3 and 4 (former Buildings 210 and 209, respectively) on Iona Island. The explosion destroyed Shell Houses 3 and 4, and their contents, and damaged Shell Houses 1 and 2 (former Buildings 115 and 116, respectively) (USACE 1998). Some of the contents of the explosion thought to be included were 13-inch (in.) shells that may have been thrown out from the point of the explosion (Shell Houses 3 and 4) as far as 1,250 feet (ft). Other munitions stored in the area during the time of the explosion included 1-pounders, 6-pounders, and 6-inch ammunition. It is expected that the explosion involved black powder rather than high explosives.

During World War I, almost all the depth charge bombs and ammunition used in the Atlantic area passed through Iona. In 1914, work increased by approximately 14 percent. All submarines were sent to Iona Island to be filled with explosives, in addition to the regular work conducted there. In 1915, over two million pounds of powder were made up in charges and about 327 rail carloads of material were handled during the year and large shipments made by transport, tug, and barge. A 1919 annual report to the Secretary of the Navy states that most of the 14-inch ammunition for the Army and Navy Railroad battery was prepared at Iona Island.

After World War I, although Iona Island was one of two of the Navy's main depots on the east coast, a program of reducing personnel and material and keeping active work to a minimum was followed under the United States' general program of limitation of arms treaty. In the 1930s, Iona

[2] Historical records revealed discrepancies in the total acreage of the Iona Island Naval Ammunition Depot. Thus, 120 acres is the average of these sources (USACE 2004b).

Island supplied ammunition of calibers to the fleet for service allowances, target practice, and reserve war requirements.

Between 1941 and 1945, the major activity conducted on Iona Island was assembling naval ammunition for World War II. More than 2,300 Navy ships and 2,300 merchant ships received their ammunition from Iona Island during World War II. In addition, 77 bases, 500 shore stations and 700 foreign naval ships were serviced with ammunition.

After World War II, use of the island as an ammunition depot became obsolete because of lack of expansion room to accommodate new types of ammunition. In 1947, the Department of the Navy decided to deactivate the Iona Island Naval Ammunition Depot and made the property available for restricted lease. The FUDS was re-designated as an Annex to the United States Naval Ammunition Depot, Earle, New Jersey, and in 1957, declared the Annex excess. In 1955 and 1960, the GSA utilized the Iona Island Naval Ammunition Depot FUDS through a permit for stockpile materials such as rubber and copper. In 1960, the GSA received official jurisdiction of the property and other agencies under GSA control utilized the property for record storage during the 1960s. These agencies included the following: Maritime Administration, Atomic Energy Commission, Civil Service Commission, Army Corps of Engineers, and the Navy's Bureau of Ships. The Maritime Administration also conducted occasional trans-shipments of heavy freight at the main wharf on an occasional basis. On 30 March 1965, Iona Island was deemed evacuated after the last load of stockpiled materials left the property. In 1965, the PIPC acquired both Iona and Round Islands (USACE 1998).

SITE LAYOUT

At the time of purchase in 1899, Iona Island consisted of 116 acres of rough, rocky, and partly wooded ground and 13 acres of marsh. The island was transformed into an ordnance depot, first called Naval Magazine and changed prior to World War I to United States Naval Ammunition Depot (AGC 2018).

Iona began as a relatively small installation. According to a 1939 Public Works of the Navy, Iona Island, NY building inventory (U.S. Navy 1939), by 1902 the following buildings had been constructed: four magazines, two fixed ammunition houses, four shell houses (fixed ammunition), three storehouses, one power house with steam, electric, and air-compressing plant, three storehouses; six hose houses, one pumphouse, one testing laboratory and telephone exchange, one locomotive house, a tin, electrical and annealing shop, one house for gunner's residence (inspectors quarters), four double cottages for principal employees, an administrative building, gatehouse, and a stable and barn. In 1903, one shipping house and two magazines were built. By 1910, four additional hose houses, two filling houses (one bombproof), three magazines (one for bulk Explosive D), one quilting house, one primer house, one tank repair house, one pump house located by the dock, a paint and oil storage building, paint and pipe shop, labor office and dispensary, a garage and greenhouse were built. By 1920, an ammunition box storage building and cartridge case storage buildings were built, one hose house, two fuse houses, eight magazines including two subsurface magazines, one gun-cotton magazine and a dynamite magazine, one shell house and D plant, one shipping house, one storehouse, powder tank storage, a standpipe, stone crusher, a heating plant for filling houses No. 2 and No. 5, a paint and oil locket, blacksmith shop, one personnel quarters and a marine barracks, a time-clock house, wagon shed, lumber shed, garden tool house, garage and cow barn.

In 1924, a total of 106 buildings including two water storage tanks and one standpipe were present at Iona Island (USACE 1998). In the late 1920s through the 1930s, various programs of maintenance and remodeling were carried out by the Bureau of Yards and Docks in addition to other several buildings being built. For example, ten magazine buildings were remodeled for fireproofing; three black-powder magazines and a railroad track to serve them were ordered; and two water tanks were provided, the water system enlarged, and two engine-driven generators installed. In addition, a dump area is first identified between Round Island and Iona Island on a 1930-dated U.S. Navy layout plan (AGC 2018).

Round Island, the southernmost portion of the depot, was utilized by the Navy for ammunition storage. The Navy filled in the area between Iona Island and Round Island to provide a connection between the two islands. Subsurface magazines were quarried out of rock on Round Island, and the rock removed was used to create a blast barrier between the magazine storage and the depot activities on Iona Island (Bluestone Environmental Group, Inc. [Bluestone] 2018). During interviews conducted as part of the 1998 Archives Search Report (ASR), maintenance personnel from the sign shop reported that ammunition could be seen in the Hudson River during low water conditions in the "dump" area. Aerial photos in the ASR Report locate this "dump" area south of the former piers and east of former waters’ edge near Round Island (USACE 1998).

In 1951 when the depot was deactivated, there were 146 buildings on the island (AGC 2018). A 22 June 1965 letter presented in the ASR provides information on the site layout at the time of DoD transfer to PIPC: the roads on the island were in poor condition, with many of the buildings not served by roads. Instead, buildings served by railroad, with spurs from the West Shore Railroad leading to each warehouse and to the pier. Most buildings had been between 1914 and 1918 and were made of brick, while additional buildings constructed in 1941 were made of concrete faced cinder block. Most buildings had no natural or artificial lighting, heating, or other utilities; they were large, open warehouses with high ceilings and no partitions or separation of floors. Several homes were also present on the island, and previously served as residences for naval officers. The homes were vacant but well maintained. Redevelopment for industrial or warehousing use would have required extensive renovation of buildings, clearance of structures, and construction of roads, parking logs, and new sewer system and utility lines (USACE 1998).

Most buildings and structures were demolished and removed between November 1965 and December 1973 (AGC 2018). It is possible that fill material was used during regrading following demolition and the soil was reworked. The FUDS has remained undeveloped since its transfer from DoD ownership to PIPC in 1965. PIPC developed demolition plans for the remaining buildings and for construction of a recreational park; however, the plans to develop the island into a recreational park were not executed. The only construction that occurred on the island was the parking lot located directly west of Iona Island and outside of the FUDS boundary. The contract plans illustrate the locations of the former buildings which PIPC removed except for a few buildings which currently remain onsite. The plans also illustrate a fill area (believed to be building demolition debris) that currently provides access between Iona Island and Round Island at Ring Meadow Marsh (Alion Science and Technology Corporation [Alion] 2008).

Original structures still standing include Building 201 (Empty Projectile Magazine); Building 212 (former Marine Barracks); Building 217 (Fire Station and Labor Office), Building 222 (Miscellaneous Storage Building), Building 508 (Bag Charge Magazine); and Building 603 (Pyrotechnic Magazine) (Bluestone 2018). Building 222 (Store House) is utilized by Bear Mountain State Park for shipping and receiving. Building 212 is in disrepair but has not been demolished due to concerns with asbestos. The old roads in the main part of the former depot (near former Buildings 123 and 410) are still accessible by vehicle. The fill area between Round Island and Iona Island is vegetated, however solid ground allows the area to be is traversable by foot.

Previous Investigations

Archive Search Report (ASR) (USACE 1998)—Through interviews, archive research, and a site investigation conducted by USACE, it was determined that ordnance associated with the Iona Ammunition Depot consisted of small arms; projectiles, projectile fuzes and propellant; rockets; bombs and bomb fuzes; pyrotechnics; bulk black powder, and high explosives. Fillers included high explosives, incendiary and smoke. During the site visit USACE inspectors observed several ordnance items that had been recovered from Iona Island Naval Depot after the Park Service had taken possession. These items were lying in a pile at the Trail Side Museum at Bear Mountain State Park. These items included unfired projectiles ranging from 8 to 16 inches in diameter along with two 10-inch cannonballs. USACE site inspectors were informed that the two cannonballs had come from one of the buildings once occupied by the Marines and speculation is that the cannonballs may have been display pieces. The origin of the other projectiles is unknown. The team recommended to the Park Ranger that he notify the U.S. Army EOD Detachment at Fort Monmouth, New Jersey. The EOD unit determined all items were empty and free of explosives.

The Park Police and Park Rangers had no past incidents on record of any live munitions being found on the Island. However, in an interview prior to the site inspection, a Bear Mountain State Park Ranger recounted a story of kids finding a grenade near Buildings 311 and 314. The demolition team from Fort Smith took care of the grenade. It is not known if the grenade was live or expended. Additionally, interviews revealed ordnance may have been intentionally dumped or accidentally dropped into the river and shells have been identified on the shore occasionally.

The USACE inspection team also spoke to maintenance personnel from the sign shop. This facility is located on Iona Island, and the personnel were very familiar with the property. The USACE inspection team was shown a collection of ordnance debris that had been found in various locations on the island. All items were expended and had no visible explosive residue and included: small arms cartridge cases, 6-pound projectile cartridge case, signal flare, and a fragment from a 3.5-in. rocket warhead. Maintenance personnel stated that during low water conditions ammunition could be seen in the river near the old "dump site" on Round Island. No ordnance was seen in the river at the time of the site visit. However, the team did locate one empty 20-millimeter (mm) cartridge case along the river's edge. This item was an inert casing identified by the inerting holes drilled in the case. No other ordnance or explosive debris was found during the inspection of the site. The USACE inspection team found no indication that any ordnance or explosives were buried on site.

Based on the 1,250-ft kick-out radius of 13-in. shells that were reportedly part of the 1903 explosion, the ASR determined a range footprint of 124.2 acres for the MRS (Figure 10-1).

MMRP Site Inspection (Alion 2008) - With support from EA, Alion performed an SI under contract to the U.S. Army Engineering and Support Center in Huntsville and USACE Baltimore District. The purpose of this MMRP SI was to evaluate the presence or absence of MEC and MC related to historical use of the site.

A qualitative reconnaissance was completed during low tide of the eastern boundaries of the MRS along the former dock areas, areas where ordnance items were historically observed at low tide, and at the dump site. No MD or MEC was observed during the 2007 SI field visit on the FUDS or near the shoreline (Alion 2008).

Figure 10-2 shows the 2007 SI soil and sediment sample locations. A total of 23 surface soil samples (including five background samples) were collected from the 1903 Explosion MRS using a 7-point wheel composite method, from 0 to 2 in. below ground surface (bgs) (Alion 2008). Five sediment samples (including three background samples) were also collected. The background samples were collected from an area west and upgradient of the FUDS boundary and outside of the limits of the 1903 Explosion Area. Locations selected were from areas deemed unimpacted by past DoD or current owner operations and were of similar soil characteristics as the biased soil samples. There was no observed visual or magnetic evidence of MEC, MD, or other military-related disturbance at background sample locations.

Prior to sampling, research was conducted to focus the list of analytes to MC potentially associated with the munitions used when the FUDS was active (Alion 2008). As a result, the soil and sediment samples were analyzed for:

- Select Target Analyte List Metals—antimony, copper, lead, nickel, and zinc (EPA Method 6010B) and mercury (EPA Method 7471A). Iron was also a MC of concern for the MRS, but it was not analyzed during the SI sampling event, because it is not a CERCLA hazardous substance (Alion 2008).

- Explosives—2,4,6-TNT; 4-amino (AM)-2,6-dinitrotoluene (DNT); 2-AM-4,6-DNT; 2,4-DNT; 2,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-nitrotoluene (EPA Method 8330A); and nitroglycerin (EPA Method 8330).

No surface water or groundwater samples were collected. Screening-level human health and ecological risk assessments were performed using the 2007 MC sampling and analysis results. Chemical concentrations were compared to applicable human health criteria (residential for soil, residential and industrial for sediment), ecological screening values, and background concentrations.

Two explosives (2,4,6-TNT and 4-amino-2,6-DNT) were detected, but at concentrations below applicable human health and ecological screening values in one of the 18 surface soil samples (II-EA-SS-02-08). The other 12 explosives were not detected above laboratory reporting limits. There were no explosives detected in the sediment samples.

Lead concentrations exceeded background concentrations and human health screening criteria in sediment samples but were below the industrial soil criteria in surface soil samples. Antimony, copper, and lead exceeded background concentrations and associated ecological screening values in surface soil. In sediment, antimony, copper, lead, nickel, and zinc exceeded background concentrations and ecological screening values.

The SI recommended that a RI/FS be performed for both MEC/MD and MC, based on historical discoveries of MD, potential for MEC/MD to remain on site, and potential for risks to human health and ecological receptors from metals MC in surface soil and sediment (Alion 2008). Note: MC are being addressed during the HTRW RI.

PHYSICAL PROFILE

Original structures still standing include Building 201 (Empty Projectile Magazine); Building 212 (former Marine Barracks); Building 217 (Fire Station and Labor Office), Building 222 (Miscellaneous Storage Building), Building 508 (Bag Charge Magazine); and Building 603 (Pyrotechnic Magazine) (Bluestone 2018). Building 222 (Store House) is utilized by Bear Mountain State Park for shipping and receiving. Building 212 is in disrepair but has not been demolished due to concerns with asbestos.

The old roads in the main part of the former depot (near former Buildings 123 and 410) are still accessible by vehicle. The fill area between Round Island and Iona Island is vegetated, however solid ground allows the area to be is traversable by foot. Although, “No Trespassing” signage is posted at the entrance gate, access to the site is unrestricted.

Climate

The climate in Rockland County, New York is classified as humid continental and subjected to some modification by the Atlantic Ocean Minimum temperatures average 21.1 degrees Fahrenheit (°F) in January and maximum temperatures average 81.6 °F in July (USACE 1998). Mean monthly air temperatures below 40 °F occur from December through March and freeze dates with temperatures below 28 °F generally occur from late October to mid-April (U.S. Department of Agriculture, Soil Conservation Service 1990).

Precipitation averages from 35 to 49 in. annually, with over half of the precipitation (26.14 in.) falling between May and October (National Oceanic and Atmospheric Administration 2017). Annual snowfall averages 26 in. The average wind direction is southerly, with the highest mean monthly velocities of over 10 miles per hour occurring in February, March, and April (USACE 1998).

Physiography and Topography

Iona Island is in the Hudson Highlands physiographic province of the New England Uplands. The surface of the New England Upland slopes southeastward from maximum inland altitudes around 2,200 ft to approximately 400 to 500 ft at its seaward edge (USACE 1998).

The Hudson Highlands is part of a northeast-trending mountain mass extending from Pennsylvania to Connecticut. The Hudson River cuts through the Hudson Highlands in a 15-mile-long relatively straight, north/south-oriented, narrow, steep-sided gorge with bedrock flanks between West Point and Peekskill, New York. Channel width in the Hudson Highlands region is less than 0.6 miles (Yozzo et al. 2005). Maximum relief is about 1,600 ft where the Hudson River dissects the Hudson Highlands. Topography is relatively rugged with prevalent bedrock-controlled landforms (New York State Department of Transportation 2013). Erosional and depositional effects of glaciation are widespread and conspicuous in the Upland.

Iona Island is a 556-acre bedrock island of the Hudson River. The southeastern part of the island, once cut off by marshes, is known as Round Island. It was attached to the south end of Iona Island with fill in the early 20th century. The hill on the western side, south of the railroad tracks, was also once treated as separate and referred to as Courtland Island.

Iona Island has rock-like terrain, with varying degrees of slopes. Elevations range from 0 ft National Geodetic Vertical Datum along the shoreline to 75 ft National Geodetic Vertical Datum (USACE 1998).

Soils and Sediment

Most of the native soil on Iona Island has been filled, built on at one point in time, and/or paved (USACE 1998). Native soil remaining at Iona Island and the mainland is derived from glacial till and is shallow, acidic, and nutrient poor (Yozzo 2005). In many areas, the soil at the Iona Island Naval Ammunition Depot FUDS has been filled in or paved (Bluestone 2018). The following soil mapping units were located on and immediately adjacent to Iona Island (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 2018).

- Chatfield-Rock outcrop complex; 4 to 16 percent slopes
- Hollis-Rock outcrop complex; 35 to 60 percent slopes
- Ipswich mucky peat; 0 to 2 percent slopes, very frequently flooded.

The Chatfield-Rock outcrop is classified as well-drained gravelly-sandy loam soil, 20 to 40 in. deep to the restrictive feature. The Hollis-Rock outcrop is somewhat excessively drained, with 8 to 23 in. to the restrictive feature. The Ipswich mucky peat soil is classified as very poorly drained, with more than 80 in. to the more restrictive feature, and up to 59 in. of muck and mucky peat (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 2018).

Muddy sediments dominate the Hudson Highlands section of the Hudson River, and there is a complicated pattern of dynamic and depositional environments between the non-depositional bedrock outcrops, which are found along the river margins (Nitsche et al. 2007). Sediments in the tidal marshes and shallows west of Iona Island consist of peat and silt and are more than 100 ft deep (U.S. Department of Commerce NOAA and NYSDEC 1982).

Photographs taken during ASR (USACE 1998) and the SI (Alion 2008), as well as recent photos taken in May 2018, October 2018, and November 2018 indicate that the shoreline along the Hudson River and Doodletown Bight areas consists primarily of riprap, gravel, cobbles, boulders, and exposed bedrock. Visual evidence of the immediate shoreline north of the dump area between Round Island and Iona Island indicates a retaining wall spanning the shoreline, with large boulders present in the river. Aerial photographs and orthoimagery indicates that the wall is not present along the shoreline in the area of the northern dock (Figure 1-2); exposed shoreline with gravel, cobbles, and boulders is visible in this area on recent orthoimagery.

The western and southern portion of the island is separated from the adjacent marshes by the active River Subdivision (CSX Transportation) railroad tracks. The southern shoreline is separated from Ring Meadow by a fill area emplaced after navy transfer of the FUDS to PIPC.

A limited area of exposed sand and gravel shoreline area is present along the shoreline of the dumping area; sediment was collected from this area during the SI (Alion 2008). This shoreline area changes to cobbles and boulders (riprap) extending southward along Round Island. Additional information on locations of exposed shoreline areas with sediment is not available. In addition, the existence of a shelf extending from the shoreline to the central channel of the Hudson River is unknown.

Overburden and Bedrock Geology

Field notes from the 1996 investigation document overburden at Iona Island as fill material overlying fine to coarse sand, with some silt and gravel. Overburden at Iona Island is shallow, with bedrock encountered at depths of approximately 25 in. bgs during the Greeley-Polhemus Group soil sampling event in October 1996 (USACE 1998).

The bedrock of the New England Upland and Hudson Highlands is folded, faulted, and includes metamorphosed sediments that have been intruded by numerous plutonic masses (USACE 1998). The rock is resistant to erosion and forms rocky knobs on Iona Island that project 100 ft above the Hudson River. Based on the bedrock geology map for the Lower Hudson, bedrock at Iona Island consists primarily of biotite-quartz-plagioclase paragneiss (Fisher et al. 1970).

Hydrogeology

Groundwater at and near Iona Island is found in both overburden and underlying bedrock. Groundwater in overburden at Iona Island was encountered at a depth of 2 ft near the former dump area between Iona Island and Round Island during the October 1996 soil sampling event, likely because bedrock is close to the surface and infiltration, where possible, is very slow (Greeley-Polhemus 1997). Shallow groundwater is likely influenced by the Hudson River.

Crystalline bedrock of the Hudson Highlands acts as a relatively poor aquifer. Groundwater in the gneiss and granitic rocks only occurs in fractures and joints (Heisig 2010). Bedrock groundwater at Iona Island is likely encountered at depths greater than 6 ft as based on the rock outcrop soil description reported in the Rockland County Soil Survey (Bonnell 1990).

Groundwater recharge is primarily from infiltration of local precipitation, with downward seepage of water through overburden into underlying bedrock and/or direct infiltration of precipitation on exposed bedrock surfaces. Upward seepage of water from bedrock also recharges surficial deposits in low-lying areas. Shallow groundwater flow in surficial deposits and weathered bedrock likely follows topography, with discharge to surface water bodies (i.e., Hudson River). Due to the crystalline nature of the bedrock, groundwater flow is restricted to joint and fracture systems that generally trend northeast-southwest (Olcott 1995).

Groundwater usage in the Hudson Highlands is largely limited to domestic wells along the periphery of the parklands. Maximum yields of wells completed in the crystalline rocks rarely exceed 70 gallons per minute, and limited aquifer storage in crystalline rock makes such wells susceptible to decreased yields during dry periods unless they are in hydraulic connection with surface water (Heisig 2010).

Hudson River and Surface Water

Iona Island is bordered on the east by the Hudson River; on the northwest by the mouth of Doodletown Bight, an expanse of shallows and mudflats; on the west and southwest by Iona Island Marsh, a tidal marsh that occupies one mile between Iona Island and the mainland. Iona Island is separated from the mainland by Snake Hole Creek on the south and Doodletown Brook on the west and north. There are no surface water bodies or drainages on the land-portion of the island within the FUDS boundary, however many areas of the island and adjoining marshes are influenced by the Hudson River.

The Hudson River originates in the Adirondack Mountains of Upstate New York, and flows southward 315 miles to the Atlantic Ocean at New York Harbor, between New York City and Jersey City. Iona Island is located 41.2 miles upstream from New York Harbor and approximately 30 miles upstream of The Bronx, NY. Maximum river depths are found in the Hudson Highlands between West Point and Peekskill, New York, with the deepest point of 196 ft at West Point. The lower half of the Hudson River from Troy to New York Harbor, a distance of 125.5 miles, is an estuary (drowned river valley) affected by semidiurnal tides, with two highs and two lows occurring within a 25-hour period (Yozzo et al. 2005).

Iona Island is located 41.2 miles upstream from New York Harbor and approximately 30 miles upstream of The Bronx, NY. The section of the Hudson River at Iona Island is very narrow and deep, with strong currents and a rocky bottom substrate. The width of the Hudson River at Iona Island is approximately 0.3 mile east of Iona Island, and the river in this area has a depth of approximately 165 ft. Tidal influence at Iona Island is approximately 3.5 ft, and shorelines may not be accessible during high tide conditions (Alion 2008).

Ecological Habitats

Habitats surrounding Iona Island include brackish intertidal mudflats, brackish tidal marsh, freshwater tidal marsh. Terrestrial habitats on the island consist of deciduous forested uplands. Specific habitats are described in more detail in the following paragraphs.

An intertidal marsh encompasses approximately 225 acres between Iona Island and the western shore of the Hudson River and is one of the largest, undeveloped tidal wetlands on the Hudson River (Yozzo et al. 2005). The National Wetlands Inventory (USFWS 2018) classifies the marsh as an estuarine and marine wetland (E2EM1N6 – estuarine, intertidal, emergent, persistent, regularly flooded, oligohaline 0.5–5 parts per thousand salinity). Tidal mudflats submerged aquatic vegetation beds, and small areas of rocky uplands also occur in the area. In Doodletown Bight, the northern portion of the marsh, mudflats are visible at low tide (Yozzo et al. 2005).

The southern end of Iona Island has two areas listed as freshwater forested/shrub wetland (palustrine, scrub-shrub, broad-leaved deciduous, temporary flooded-tidal). There is also a small (0.35 acre) freshwater emergent wetland on the western side of the island (palustrine, emergent, persistent, semi-permanently flooded) (USFWS 2018). The Hudson River is classified as estuarine and marine deep water (estuarine, subtidal, unconsolidated bottom, subtidal, oligohaline 0.5–5 parts per thousand salinity).

Native vegetation within the marsh is dominated by narrow leaf cattail (*Typha angustifolia*) with common reed (*Phragmites* spp.) and swamp rose mallow (*Hibiscus moscheutos*). Crack willow (*Salix fragilis*) is present at the mouth of Doodletown Brook within the tidal swamp. Compaction of soil, saltwater intrusion, and site disturbance have resulted in a significant presence of invasive species (estimated at 60% of the vegetation on the Island). Recent wetland restoration has been conducted on site, with approximately 50% of the marsh restored from invasive species (including *Phragmites* spp.) to native vegetation such as cattails (Bluestone 2018).

Iona Island Marsh is especially important for marsh-nesting birds. Probable or confirmed breeding species include herons, least bittern (*Ixobrychus exilis*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), Virginia rail (*Rallus limicola*), belted kingfisher (*Ceryle alcyon*), marsh wren (*Cistothorus palustris*), and red-winged blackbird (*Agelaius phoeniceus*). Large concentrations of herons, waterfowl and shorebirds occur during spring and fall migrations (March–April and September–November, respectively).

Resident wildlife species in the area include muskrat (*Ondatra zibethicus*), white-tailed deer (*Odocoileus virginianus*), box turtle (*Terrapene carolina*), Northern water snake (*Nerodia sipedon*), timber rattlesnake (*Crotalus horridus*), red fox (*Vulpes* Vulpes), rat snake (*Pantherophis* spp.) and green frog (*Rana clamitans*).

The upland terrestrial areas of the island consist of deciduous, rocky woodland communities including oaks (*Quercus* spp.), ashes (*Fraxinus* spp.), birches (*Betula* spp.), willows (*Salix* spp.), red maple (*Acer rubrum*), and elms (*Ulmus* spp.). The woodlands are maintained for their value as cover, perch sites, and buffer zones.

Threatened and Endangered Species

Threatened species are species that may become endangered if conditions surrounding the species begin, or continue, to deteriorate. Endangered species are species whose prospects for survival in an area are assumed to be in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, or disease. Species of special concern is any species that does not meet the criteria of an endangered or threatened species but is particularly vulnerable and could easily become an endangered, threatened, or extirpated species due to restricted distribution, low or declining numbers, specialized habitat needs or limits, or other factors. Special concern species are established by policy, not by regulation, and are used for planning and informational purposes; they do not have the legal weight of endangered and threatened species.

Bird species and their status for New York are provided in the following table.

Species	Common Name	Status
Haliaeetus leucocephalus	Bald eagle	Threatened
Ixobrychus exilis	Least bittern	Threatened
Setophaga cerulea	Cerulean warbler	Special Concern
Vermivora chrysoptera	Golden-winged warbler	Special Concern
Pandion haliaetus	Osprey	Special Concern
Circus cyaneus	Northern harrier	Threatened
Podilymbus podiceps	Pied-billed grebe	Threatened

The National Marine Fisheries Service (NMFS) identifies the following species that are known to or are believed to occur in Rockland County, New York and are provided in the following table:

Group	Species	Common Name	Status
Plants	*Isotria medeoloides*	Small whorled pogonia	Threatened
Mammals	*Myotis sodalis*	Indiana bat	Endangered
Mammals	*Myotis septentrionalis*	northern long-eared bat	Threatened
Reptiles	*Clemmys muhlenbergii*	bog turtle	Threatened

In addition, Atlantic sturgeon (*Acipenser oxyrhynchus*) and shortnose sturgeon (*Acipenser brevirostrum*) live primarily in the ocean but migrate to coastal rivers for spawning. In New York, spawning and nursery grounds for juveniles are located in the Lower Hudson River. Both species are classified as Endangered by NMFS and are protected in the State of New York.

RELEASE PROFILE

This section presents a discussion of the potential sources of MEC and associated MC, their release mechanisms, and interactions to potential receptors for the MRSs.

Sources and Release Mechanisms

Anticipated MEC

Although no confirmed MEC items have been found to date at the FUDS, one potential source area for MEC at the FUDS is within the MRS-01 1903 Explosion Area from the 1903 explosion that occurred between two shell houses (Buildings 210 and 209); destroying the buildings and their contents. As a result of the explosion munitions items could have potentially kicked out from the explosion as far as 1,250 ft and include 13-in. projectiles.[3] Other munitions stored in the area during the time of the explosion included 1-pounders, 6-pounders, and 6-in. projectiles. Additionally, a hand grenade was reportedly found within the MRS. It is not known if the grenade was live, a practice item, or expended (USACE 1998).

A second potential source area for MEC is underwater in the sediment at the former loading docks and along the shoreline at and in the vicinity of the loading docks based on anecdotal information that munitions were dumped and/or dropped into the river during loading operations. The types of munitions dumped and/or dropped is unknown. There was a wide variety of ammunition of all calibers associated with the Iona Naval Ammunition Depot including small arms, cartridges (ball, blank, dummy, gallery), primers, detonators, unloaded and loaded projectiles (common, target, armor-piercing [AP], shrapnel), projectile fuzes, grenades (rifle, hand), rockets, naval mines, depth charges, aero bombs, bomb fuzes and pyrotechnics. Fillers included high-explosive, incendiary and smoke (ASR 1998).

A third potential source for MEC is an area referred to as a "dump site" located between Iona Island and Round Island that was reported to have visible munitions in the shallow near-shore sediments during low tide conditions. The types of munitions that were visible are not known, but, again, would have been associated with the Iona naval Ammunition Depot and included a wide array munitions. It is also not known if the munitions sighted are the result of disposal at the "dump site" or migration from dumping and/or dropping of munitions at the former loading docks. A 20-mm casing was discovered along the riverbank during the ASR site inspection.

During the ASR site visit, the following munitions debris and projectiles were inspected and found to be either expended or empty (USACE 1998):

- 1-pounder Projectile
- 6-pounder Projectile
- 6-in. Projectile
- 8-in. Projectile, armor-piercing high explosive (APHE)
- 12-in. Projectile, APHE
- 13-in. Projectile, SHOT
- 16-in. Projectile, APHE

[3] Radius was determined as part of the ASR (USACE 1998) and was based on DoD 6055.09-STD, DoD Ammunition and Explosives Safety Standards, dated October 1992.

- 10-in. Cannon Ball, Shot
- 3.5-in. Rocket Head
- Ship's Emergency Identification Signal, Mk 3, Smoke (expended)
- Cartridge Case, 20mm (Inert, inerting holes present in case).
- Small Arms, General

Expected Depth of MEC

During previous investigations, MD and MPPEH were observed on the ground surface. Although the expected depth for most MEC is on the surface or within several inches of the surface, based on the CSM that the distribution of MEC via the 1903 explosion, dumping and/or dropping of munitions, there is a potential that MEC could be in the subsurface. Based on the physical profile of site soil and depth to bedrock, the maximum depth of MEC is anticipated to be less than 2 ft.

Anticipated MC

As part of the MMRP RI, the potential for MC (metals and explosives) presenting an explosive risk (i.e. present at concentrations high enough to present an explosive hazard) is associated with the identification of a MEC item during the MEC investigation. No confirmed MEC items have been found to date at the FUDS, and results from the SI did not indicate MC at concentrations high enough to present an explosive hazard.

The identification of a breached MEC item may indicate that the metals and/or explosive contents could have leached to environmental media directly below the item. Sampling of environmental media for MC (metals and explosives) associated with former DoD usage of the site is being conducted as part of the HTRW RI and is discussed in the HTRW UFP-QAPP.

LAND USE AND EXPOSURE PROFILE

Land Use

Iona Island was designated a National Natural Landmark in 1974 by the National Park Service and is currently under the administration of the PIPC and maintained by staff of Bear Mountain State Park. Public use at the island is limited to educational outings and history tours. Site access is limited to authorized employees of Bear Mountain State Park who use a few of the remaining buildings for storage, to researchers who work in the marsh areas, and to guided tour groups six to eight times a year between May and October. The island is partially fenced, and the main gate is unmanned, which allows for unrestricted access to Iona Island from Bear Mountain State Park. Boating along the Hudson River is open to the public, and because the shoreline of Iona Island is not fenced, there is potential for recreational users of the Hudson River to access the island via the shoreline. Although the island was historically used for camping, camping is no longer conducted because the island is not regularly patrolled by the Park Service and there are physical hazards (not related to previous military use of the site).

In 1965, when GSA conveyed the property to the Palisades Interstate Park Commission, it was under a "restrictive clause" (park purposes only). The majority of Iona Island is currently open space. There is a parking lot and scenic overlook located directly west of Iona Island. Although PIPC developed plans for construction of a recreational park, these plans were not executed. In addition, while a developer has proposed plans for constructing an environmental center/nature center, these plans have not been approved. There are no current plans to develop the island for recreational purposes and no anticipated future use of the Site other than its current use as a conservation area. There are currently no anticipated construction plans other than the possibility of converting existing buildings for use or constructing a new storehouse.

Groundwater and surface water at Iona Island are not used as a potable water source. The existing storehouse at Iona Island has a defunct water supply/waterline and may have a working well that provides non-potable water. A description of Iona Island from 1965 presented in the ASR states that water at the sewer plant was supplied by a well that pumped to a standpipe (USACE 1998).

A description of Iona Island from 1937 presented in the ASR states that a fresh water supply consisted of a rain water collection system into two reservoirs of 2,000,000-gallon capacity connected by equalizer pipe, which was pumped and stored in two steel tanks with a of combined capacity of 4,200,000 gallons. The Iona Island War Diary from 1945 presented in the ASR states that on 10 December a new water supply system involving a pipeline to Doodletown was placed in partial use pending completion of some final pump house piping. This system had sufficient capacity to furnish this Depot with its entire freshwater requirements under normal operating conditions (USACE 1998).

Land use surrounding Iona Island is recreational and military, with Bear Mountain State Park along the western shore of the Hudson River and Camp Smith along the eastern shore. The site is also surrounded by the Iona Island/Doodletown Bird Conservation Area (NYSDEC 2017). For the portions of the adjacent Bear Mountain State Park that are open to the public, recreational opportunities include hiking, boating, and bird watching. There is no public canoeing or kayaking allowed in the marshes surrounding Iona Island. Access to the marsh is limited to guided canoe and kayak trips.

Iona Island is part of the much larger Hudson River National Estuarine Research Reserve and Significant Coastal Fish and Wildlife Habitat Area, managed under New York’s Coastal Management Program (Alion 2008). In addition, the Iona Island Marsh became a registered National Natural Landmark in 1971. The island is considered a bald eagle sanctuary (Levine 2011).

Potential Human Receptors

Potential human receptors may be exposed to explosive hazards from both MEC and MC found at concentrations high enough to present an explosive hazard. Based on the identified preliminary CSM, the current and potential human receptors at the site are the following:

- Bear Mountain State Park employees
- Researchers
- Recreational users
- Campers (historical use by boy scouts)
- Construction workers
- Trespassers.

The future use of Iona Island is anticipated to remain consistent with current use and will continue to be maintained by park employees and will continue to be an important area for research. Communication with the Director of Development and Special Projects at PIPC indicates that there are no plans for construction or redevelopment at the site for the foreseeable future; however, it is possible that existing structures could be renovated or improved. Potential future work could involve repair to existing foundations. Construction workers in this limited future scenario could be potential receptors. Though not currently planned, hypothetical future plans for the Island may include recreational use and construction of a nature or retreat center.

The Island is currently used by a limited number of recreational canoers which must obtain a permit for access. Current and future recreational users include canoers and potential campers. Potential campers who would have a higher level of direct exposure to on-site soil than recreational users are considered a separate category of use.

The exposure risk associated from potential MC is being evaluated as a part of the HTRW UFP-QAPP. Details associated with the human health risk assessment can be found in the Human Health Risk Assessment Work Plan presented in Appendix D of the HTRW QAPP.

Potential Ecological Receptors

The explosive risk associated with potential MEC and MC to ecological receptors is not evaluated; only the exposure risk from associated MC (metals and explosives). MC sampling and the exposure risk associated with explosives and metals MC in environmental media attributed to former DoD usage is being evaluated as a part of the HTRW UFP-QAPP. Details associated with the ecological risk assessment can be found in the Ecological Risk Assessment Work Plan presented in Appendix E of the HTRW QAPP.)

Exposure Pathways

Munitions and Explosives of Concern

Potential human receptors may be exposed to the explosive hazard associated with remaining MEC on the surface and in the subsurface both on the land and aquatic portions of the site as a result of historic operational use and the 1903 explosion. In addition to trespassers, the FUDS is not DoD controlled and is used by many different entities, including visitors/recreational users and workers of Bear Mountain State Park, who have access areas where a potential MEC hazard may exist.

Future access restrictions are unlikely as the reasonable future site use is expected to remain the same. Potential MEC may migrate to the surface as a result of natural processes such as frost heave, wind and water erosion and storm events. Since current and future receptors present at the site will have unlimited access, and there is a potential for finding MEC on the land surface, in the subsurface, or in sediments, there is a potentially complete pathway for exposure to the hazard of MEC to human receptors at the FUDS.

Munitions Constituents

MC are considered MEC when found at concentrations high enough to present an explosive hazard (USACE 2005). The exposure pathways to MC that present an explosive hazard are the same as those pathways discussed under *Munitions and Explosives of Concern.*

In addition to explosives hazards, both human and ecological receptors may be exposed to MC in environmental media attributed to former DoD usage of the site. Exposure to MC (metals and explosives) in environmental media associated with historical DoD usage of the site is being evaluated under the HTRW RI. For an MC exposure pathway to be considered under this MMRP RI, an MC source (i.e. breached MEC item) would have to be found.

Human receptors may be exposed to MC in soils and sediment by incidental ingestion, inhalation of particulates (humans only), and dermal absorption. Ecological receptors might also be exposed indirectly to MC in surface soil and sediment by ingestion of biota that has been exposed to MC.

Breached MEC may be identified on the surface or subsurface of soils and sediments; as a result, associated MC would be anticipated in the surface soil/sediment (defined as 0 to 6 in. bgs) or the subsurface soil/sediment depending on the depth of which the breached MEC item was identified. Since a breached MEC item is an isolated occurrence, any MC would be located directly below or surrounding the breached MEC item depending on the orientation. Construction workers and ecological receptors would have the greatest potential for exposure as the potential MC would be located bgs.

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\\loveton\GIS\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\WorkPlan\Figure 10-1 Iona Island FUDSMRS-01.mxd

0 450 900
Feet

N

Legend

- Dump Site
- Former Dock
- FUDS Boundary
- MRS-01 1903 Explosion Area

FIGURE **10-1**
IONA ISLAND FUDS
SITE MAP

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 10/03/2018

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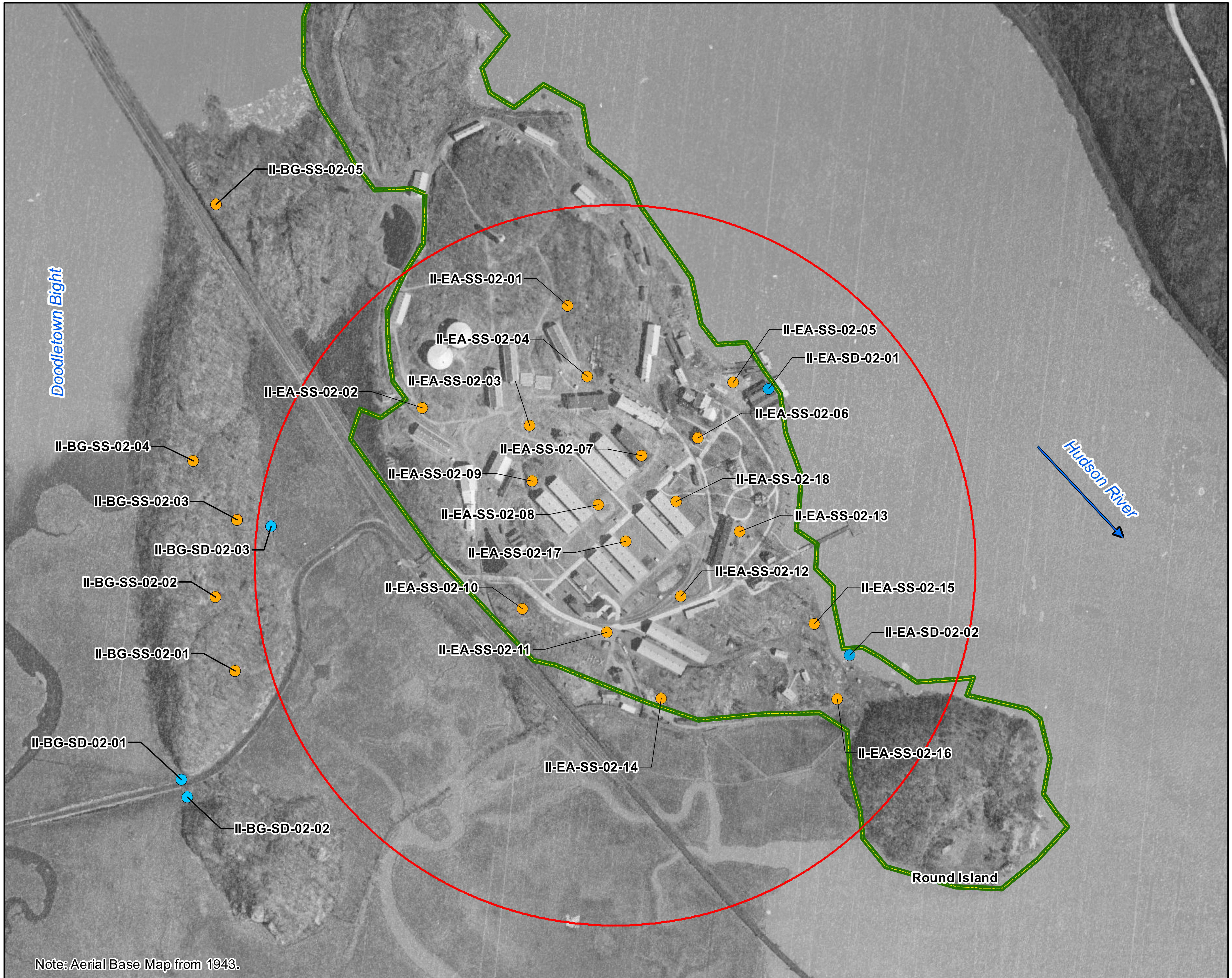

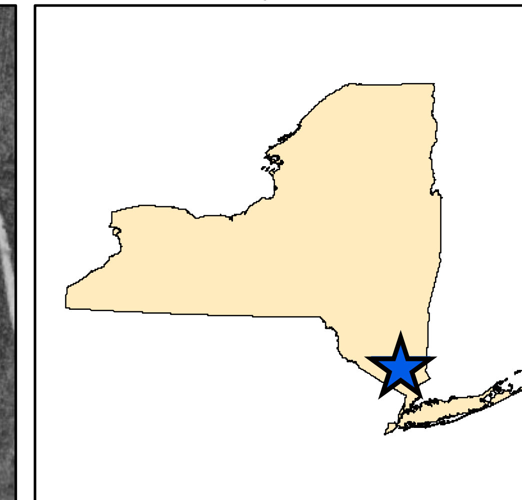

Legend

- FUDS Boundary
- 1903 Explosion Area
- 2007 Surface Soil Sample
- 2007 Sediment Sample

0 400 800
Feet
1 in = 400 ft

N

Figure 10-2
2007 Site Inspection MC Sample Locations

UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN
MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION

Aerial: ESRI ArcGIS Online Map Service
Source: Alion 2008

Map Date: 4/5/2019

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QAPP Worksheet #11: Project/Data Quality Objectives

An integral part of developing a UFP-QAPP and planning an RI is defining the DQOs. The DQOs are qualitative and quantitative statements that define the type, quantity, and quality of data necessary to support the decision-making process during the RI. The overall project DQOs for MEC were developed using the EPA 2006 guidance document entitled *Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4* (EPA/240/B-06/001) (EPA 2006). The DQOs were developed using the following seven-step process:

Step 1: State the problem.

Previous investigations have indicated that MEC in the form of DMM may be present at Iona Island resulting from its use as an ammunition depot from 1900 to 1947 that included the 1903 shell house explosion (MRS-01 1903 Explosion Area) and the potential dumping and/or dropping of munitions at the loading docks and a previously identified dump site between Iona Island and Round Island. Based on anecdotal information, munitions have previously been identified on the shoreline downstream from one of the loading docks near the dump site (Figure 10-1). Munitions that have been found within the study area during previous studies are listed in Worksheet #10. As shown in the CSM in Worksheet #10 these materials, if present, may present an unacceptable risk from explosive hazards to current and anticipated future land users. The overall density and distribution of MEC within MRS-01 and the FUDS as currently defined has not been determined. Therefore, the problem to be addressed during the RI is to identify the extent of MEC that may remain at Iona Island on the surface and in the subsurface through the collection of data within the MRS-01 1903 Explosion Area and the other areas within the FUDS where DMM is suspected (i.e., former loading docks, shoreline at and in the vicinity of former loading docks, and the previously identified dump site). Depending on the types and distribution of MEC remaining at the site, a FS may be required to evaluate remedial action may be required to mitigate the MEC hazard to current or reasonably anticipated future receptors. Results of the investigation will be used to evaluate site hazards from MEC.

Step 2: Identify the goals of the study.

The primary goal for the RI is to determine if MEC presents a potential hazard to human health at the site. MEC data collected will be sufficient to support accurate cost estimating for remedial actions presented in the FS, if required.

<u>Principal study questions:</u>

1. What is the nature and extent of MEC on Iona Island, specifically at MRS-01 1903 Explosion Area, at the former munitions loading docks, along the shoreline at and in the vicinity of the loading docks, and at the dump site?

2. What current and potential future threats may be posed to human health by MEC?

Study Goals for MEC:

- Establish the nature and extent of MEC across MRS-01 within the statistical confines presented in Step 5 of the DQOs using DGM, AGC, and intrusive investigations;

- Establish the nature and extent of MEC at the former loading docks using divers to perform an instrument assisted surface search and using underwater analog instruments perform intrusive investigations of detected subsurface contacts;

- Establish the nature and extent of MEC at the former loading docks and along the upstream and downstream shoreline of the Hudson River using DGM and intrusive investigations;

- Establish the nature and extent of MEC at the previously identified dump site using DGM and intrusive investigations;

- Support determinations of non-impacted areas;

- If MEC is present, or if has been determined that the potential for MEC at the site, determine whether MEC poses a potential hazard to human receptors. To evaluate if there are acceptable or unacceptable human health hazards due to MEC at the site, a risk assessment will be performed in accordance with the guidance document "*Trial Period for Risk Management Methodology at FUDS MMRP Projects*" (USACE, 2017) and will include a review of historical and RI MEC related findings. The risk assessment satisfies the requirements of 40 CFR Section 300.175(d)(4) and uses site-specific CSM data, likelihood of a MEC encounter, severity of a MEC incident, and likelihood of detonation.

- Collect sufficient data to support the development of an FS; remedial alternatives for potential future remedial actions, if necessary.

Study Goals for MC:

MC are considered MEC when found at concentrations high enough to present an explosive hazard (USACE 2005). If a potential source of MC is encountered during this MMRP RI (i.e. breached MEC item), or if other unexpected or unanticipated issues are encountered during implementation of this MMRP RI (for example, visual evidence of MC in environmental media), this will be documented in the daily field form and addressed through a call with the project delivery team (PDT). MC that presents an explosive hazard will be handled using the same methods as MEC items, as discussed in Worksheet #17, DFW 8: Intrusive Investigation.

MC sampling is not anticipated under this MMRP RI. MC sampling and the exposure risk to human and ecological receptors associated with explosives and metals MC attributed to former DoD usage in environmental media is being evaluated as a part of the HTRW investigation.

Step 3: Identify information inputs.

To fill the data gaps in the preliminary CSM and answer the study questions, the primary data inputs for the RI include the types, locations, and depths of MEC identified at Iona Island during the MMRP investigation and current and anticipated future land-use of the MRS.

RI field investigation and assessment inputs for MEC include:

- Results of the DGM detection survey, AGC survey, and instrument-aided geophysical surveys (if necessary) to characterize MEC and areas indicative of munitions use identified by the investigation including:
  - Grid and transect coverage and locations
  - Anomaly locations, amplitudes, and densities
  - AGC anomaly classifications (i.e., MEC, non-MEC, cannot determine, etc.)

- Results of intrusive investigation of DGM and AGC anomalies identified as TOIs and non-TOIs, and dive anomalies investigated including:
  - Anomaly type (MEC, MD, non-munitions-related debris (NMRD), seed, etc.)
  - Quantity
  - Depth of the item(s)
  - Munitions size (e.g., caliber), type (e.g., mortar, projectile, etc.), condition (e.g., fuzed, unfuzed, inert, etc.) and era (e.g., World War II)
  - Munitions' explosive hazard (e.g., type of filler)

- Data obtained during the ASR, SI

- A preliminary CSM based on previous studies, including details regarding current and potential future land use and activities, and human and ecological receptors, exposure pathways and exposure areas.

- An updated horizontal and vertical CSM based on results of previous investigations summarizing types and quantities of MEC known or suspected to be present and expected vertical distribution of MEC present (expected depth and density).

Step 4: Define the boundaries of the project.

The horizontal boundary of the study area includes the accessible land portions of the MRS-01 1903 Explosion Area boundary (Figure 17-2) and four areas within the Iona Island Naval Ammunitions Depot FUDS boundary where dumping and/or dropping of munitions is suspected. Areas where dumping and/or dropping of munitions is suspected include the three former loading docks (Figures 17-3 and 17-4). A 50-ft buffer around the footprint of each of the former loading docks will bound the lateral extent of the underwater investigation of these areas. The 50-ft buffer area would encompass the most likely areas where suspected dumping and/or dropping may have occurred. The shoreline immediately upstream and downstream from the northern two docks (i.e.

50 ft to the north of the docks as well as to the south by 50 ft) will also be included in the boundary of the investigation to include a 40-ft-wide buffer along the water's edge (Figure 17-5). The fourth area includes the footprint of the dump site between Iona Island and Round Island previously identified through the photo analysis performed by the U.S. Army Geospatial Center (AGC 2018) (Figure 17-6). Figure 11-1 shows the specific boundaries of each investigation area.

Areas that will be excluded from the investigation (and rationale) include:

- Existing buildings in MRS-01 (no expectation of MEC, inaccessible)
- Marsh areas in MRS-01 that have been filled in with riprap (unusable data due to metallic debris and the presence of riprap prevents a pathway to MEC)
- Steep/rocky slopes in MRS-01 (inaccessible)
- Marsh water channels in MRS-01 (adjacent accessible areas to be used for characterization)
- Areas adjacent to the docks where the water depth is greater than 60 ft (inaccessible, unlikely receptors). Dives will be limited to 60 ft
- Areas where the river bottom exceeds 30 degrees slope or determined acceptable by Direct Person in Charge
- Areas that are outside of the MRS-01 and where there have been no indications of dumping and/or dropping of MEC (no expectation of MEC)
- Steep shorelines including riprap/break walls (inaccessible).

The 1903 explosion and potential dumping and/or dropping of munitions are the mechanisms for MEC sources which indicate the depths for MEC are shallow. Additionally, the vertical subsurface boundary of the project is anticipated to be restricted by the relatively shallow bedrock (0–2 ft).

The temporal boundary for Iona Island includes the time it was used as an ammunition depot (1900-1947). Additionally, the temporal boundary for the investigation will be phased and include multiple mobilizations to account for seasonal considerations such as vegetation (DGM and AGC will be performed during spring prior to marsh and island growth), avoidance of avoid the key time periods and sensitive locations for wintering bald eagles (mid-December through early March, depending on winter severity) and marsh bird breeding (the nesting/fledging of the least bittern in the marsh grasses to the west of Iona Island during mid-April – mid-July), and Hudson River tides (e.g., diving will be performed during slack tide when possible for safety considerations).

Step 5: Develop the project data collection and analysis approach.

The data collection and analysis for the MMRP RI at Iona Island will involve four steps:

1. Characterizing the MRS-01 1903 Explosion Area
2. Characterizing the three former loading docks
3. Characterizing the riverbank at, upstream, and downstream of the two northern loading docks
4. Characterizing the previously identified dump site.

The project team will perform DGM on land and along the shoreline, and analog (dive) surveys in the Hudson River around the former docks to locate anomalies that may be representative of MEC, followed by intrusive investigations. In areas where building debris may be significant, or where intrusive investigations are not permitted, AGC will be performed to reduce unnecessary intrusive investigations.

1. Characterizing MRS-01 1903 Explosion Area.

DGM will be performed within grids throughout the MRS-01 boundary, followed by AGC and intrusive investigations to determine the nature and extent of MEC over the MRS. MRS-01 will be treated as a Non-Concentrated Munitions Use Area (NCMUA) as the CSM for the site is that during the explosion munitions may have been randomly distributed across the site. The explosion in 1903, originating from the approximate center of the depot, is thought to have thrown stored ammunition shells as far as 1,250 feet (ft) from the blast. However, during demolition of buildings, construction debris may also have been distributed over the same areas and would now likely be intermixed with the blast contents. Because the explosion location coincides with the area where the former ammunition depot buildings were demolished and DGM anomalies from the explosion and the demolished buildings are likely intermixed, it is unlikely a density analysis of DGM transects would be useful to define the extent of MEC contamination. A more prudent approach is to place grids throughout the MRS using a semi-biased placement to characterize the subsurface. Grids will be placed near the explosion area as well as at the furthest extent of the MRS to facilitate determination of MEC density and extent. To avoid intrusively investigating an expected high number of demolished building debris, AGC will be utilized to classify DGM anomalies as being MEC versus non-MEC. The "moderate" public use parameter within VSP has been used to determine the number of grids required to characterize MRS-01. If no MEC is found within 6 acres of intrusively investigated DGM/AGC grids, then it can be concluded with 95% confidence that the true rate for MEC is no greater than 0.5 MEC/acre. If MEC is found, then a new MEC/acre rate can be calculated at the 95% confidence.

<u>DGM Survey</u>

Parameters of interest: Geophysical anomalies exceeding the project-specific detection threshold (i.e., measurements that possess amplitudes greater than 5 to 7 times the root-mean-squared background response).

Type of inference: Measurements meeting the criteria noted above may represent MEC and will be considered for further evaluation during the Intrusive Investigation or AGC Cued Phase.

Decision rules: If a measurement meeting the criteria noted above is present in the DGM data, the anomaly will be placed on the DGM TOI list and will be selected for further evaluation during the Intrusive Investigation or AGC Cued Phase.

<u>AGC Survey</u>

Parameters of interest: Spatial extent of detected anomaly, cued measurement SNR, inversion fit coherence, and inversion outputs of magnetic polarizabilities, x, y, and z.

Type of inference: The following criteria will be used to classify the anomaly:

1. If the polarizability matches (within specifications established on Worksheet #22) that of an item in the project-specific TOI library (based on Step 4, above),

2. If the inverted polarizabilities indicate a source item large enough to be a 1-pounder, by fitting to the closest item currently within the library.

3. If four or more anomalies group (cluster) due to having similar polarizabilities, they will be added to the list under the "Priority 2" portion of the TOI list.

4. If anomalies with poor fit coherence that, after considering all available information, cannot be ruled as non-TOI will be added under the "Priority 2" portion of the TOI list.

Decision rules: The criteria above will then, in turn, lead into three simple decision rules:

1. If a portion of the study area is determined to have an anomaly density too high for cued analysis, then the area will be avoided and recommended for other investigation methods.

2. Objects classified as Priority 0, 1, and 2 will be recommended for excavation.

3. Priority 3 will remain in place, with the exception that some may be investigated under the scope of a future project or as part of QA/QC.

<u>Intrusive Investigation</u>

Parameters of interest: The sources of anomalies to determine whether the anomalies are munitions related, and if so, the horizontal and vertical distribution of munitions-related anomalies to determine the lateral and vertical extent.

Inference: The presence of MEC would indicate that the 1903 Explosion distributed MEC in the MRS.

Decision rule: If MEC is present, the distribution of the MEC observed from the investigation will be used to determine the horizontal and vertical extent (using VSP) and the CSM refined accordingly.

Post-Survey/Intrusive Analysis

Parameter of interest: DGM survey data locations, DGM anomaly locations, AGC locations and classifications, intrusive results. This data will be used run various post-survey spatial analysis using the VSP software to determine densities across the site for each anomaly type including; total DGM anomalies, total AGC anomalies, AGC non-MEC anomalies (Priority 3), MEC, and MD. Type of inference: Density maps from VSP will be used to define lateral extent and density of MEC contamination.

Decision rules: If MEC is identified within the MRS and the density maps define the lateral extent of MEC, a new MEC density calculation will be performed using the VSP TOI post-survey module and the CSM revised (e.g., elevated MEC density area is a CMUA). If the MEC/MD density maps indicate the MEC density may be higher than what is expected for a non-CMUA (i.e., munitions related density is approximately 20 anomalies/acre above background), the elevated area will be considered a CMUA and approximately 4 to 6 investigation grids will be placed within the elevated munitions area to ensure the area is characterized with respect to MEC nature and vertical and horizontal extent. Additionally, if the density maps indicate that MEC may extend beyond the MRS boundary, additional investigations will be implemented in these areas to determine the new lateral extent of MEC. If no MEC are found, the team will use the initial VSP design conclusion that the MEC density for the site is no greater than 0.5 MEC/acre at the 95% confidence level. The CSM will be refined accordingly.

2. Characterizing the Three Former Loading Docks

The area surrounding the former loading docks will be treated as potential CMUAs resulting from the possible dumping and/or dropping of munitions during loading operations. Underwater dive teams will perform intrusive investigations using underwater hand-held detectors along transects spaced 10 feet apart over each of the former loading dock footprints, including a 50 ft buffer to characterize areas adjacent to the docks where dumping or dropping of munitions would most likely occur. If evidence of MEC is found within 25 ft of the edge of the buffer area surrounding the former dock footprint, the transect on which the MEC was found, and the two adjacent transects, will be extended 25 feet. Dives will be limited to 60 ft or where the river bottom exceeds 30 degrees slope or determined acceptable by Direct Person in Charge. If no evidence of MEC is identified on those transects, the extent of MEC will be considered determined.

Parameter of interest: The sources of anomalies to determine whether the anomalies are munitions related, and if so, the horizontal and vertical distribution of munitions-related anomalies to determine the lateral and vertical extent.

Type of inference: The presence of MEC or MD would indicate that dumping and/or dropping of munitions along the loading docks, or kickout from the 1903 explosion.

Decision rule: If MEC is present, the distribution of the MEC observed from the investigation will be used to determine the horizontal and vertical extent and the CSM refined accordingly (e.g., site determined to be a CMUA). If MEC or MD is not present, the team will presume the area is not impacted by MEC and revise the CSM.

3. Characterizing the Shoreline at and in the vicinity of the Former Loading Docks

The area along the shoreline at, upstream, and downstream of the former loading docks will be treated as potential CMUAs resulting from the migration of munitions possibly dumped or dropped at the former loading docks. DGM surveys will be conducted along the shoreline 50 ft upstream as well as 50 ft downstream of each of the two northern former loading docks along transects spaced 10 feet apart and resulting anomalies intrusively investigated.

<u>DGM Survey</u>

Parameters of interest: Geophysical anomalies exceeding the project-specific detection threshold (i.e., measurements that possess amplitudes greater than 5 to 7 times the root-mean-squared background response).

Type of inference: Measurements meeting the criteria noted above may represent MEC and will be considered for further evaluation during the intrusive investigation.

Decision rules: If a measurement meeting the criteria noted above is present in the DGM data, the anomaly will be placed on the DGM TOI list and will be selected for further evaluation during the intrusive investigation.

<u>Intrusive Investigation</u>

Parameter of interest: The sources of anomalies to determine whether the anomalies are munitions related, and if so, the horizontal and vertical distribution of munitions-related anomalies to determine the lateral and vertical extent.

Type of inference: The presence of MEC or MD would indicate that dumping of munitions occurred at the loading docks and was transported downstream.

Decision rule: If MEC is present, the distribution of the MEC observed from the investigation will be used to determine the horizontal and vertical extent and the CSM refined accordingly (e.g., site determined to be a CMUA). If MEC or MD is not present, the team will presume the area is not impacted by MEC and revise the CSM.

4. Characterizing the Previously Identified Dump Site

The previously identified dump site will be treated as potential CMUA resulting from possible dumping of munitions. DGM will be collected within the previously identified dump area between

Iona Island and Round Island along transects spaced 10 feet apart and resulting anomalies intrusively investigated.

DGM Survey

Parameters of interest: Geophysical anomalies exceeding the project-specific detection threshold (i.e., measurements that possess amplitudes greater than 5 to 7 times the root-mean-squared background response), or spatially indicative of disposal pits/trenches.

Type of inference: Measurements meeting the criteria noted above may represent MEC or disposal pits/trenches containing MEC and will be considered for further evaluation during the intrusive investigation.

Decision rules: If a measurement meeting the criteria noted above is present in the DGM data, then the anomaly will be placed on the DGM TOI list and will be selected for further evaluation during the intrusive investigation. If an inordinate number of DGM TOIs are identified in the dump site following the DGM survey, then AGC may be utilized to reduce the number of intrusive investigations. EA management will evaluate the dump site for number of TOIs and make recommendations to the PDT on whether to perform intrusive only activities or supplement the investigation with AGC.

Intrusive Investigation

Parameter of interest: The sources of anomalies to determine whether the anomalies are munitions related, and if so, the horizontal and vertical distribution of munitions-related anomalies to determine the lateral and vertical extent.

Type of inference: The presence of MEC or MD would indicate that dumping or disposal of munitions occurred at the dump site.

Decision rule: If MEC is present, the distribution of the MEC observed from the investigation will be used to determine the horizontal and vertical extent and the CSM refined accordingly (e.g., site determined to be a CMUA). If MEC or MD is not present, the team will presume the area is not impacted by MEC and revise the CSM.

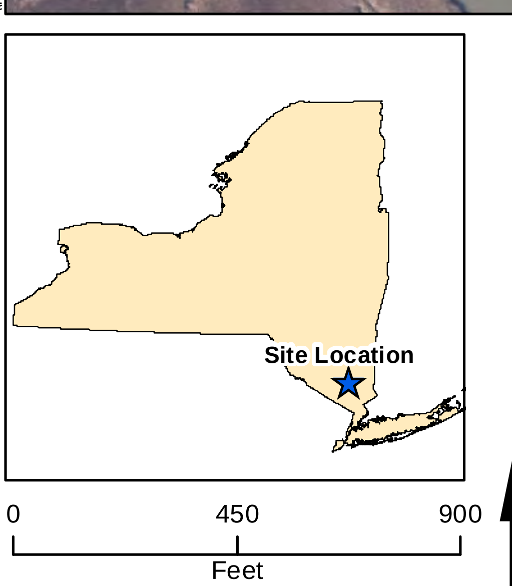
Step 6: Specify project-specific measurement performance criteria (MPC).

Overall, the baseline condition for MEC characterization during the RI is that “MEC is potentially present,” and that if MEC is present it is characteristic of the type of munitions historically stored/used at the site, whereas the alternative condition is “MEC is not present.” Conclusive data indicating that no MEC is present will be obtained prior to rejecting the baseline condition.

Project-specific MPC, based on DFWs are presented in Worksheet #12. Project-specific MPCs are the criteria that collected data must meet to satisfy the DQOs. Failure to achieve the MPCs may have an impact on end uses of the data, which will be discussed in the DUA (Worksheet #37) Report included with the RI Report.

Step 7: Develop the design.

The MPCs established during Step 6 of the DQO process (documented in Worksheet #12) were used to develop the sample design, which is described in Worksheet #17. The sample design is broken down into a series of specific processes and data collection steps, termed DFWs. Furthermore, Figure 17-1 provides a decision tree that will be used in the execution of the sample design, to evaluate the conformance of specific DFWs to established MPC.



Legend

- DGM Marine Area
- DGM Shoreline Area
- Dump Site
- Former Dock
- FUDS Boundary
- MRS-01 1903 Explosion Area

FIGURE 11-1

IONA ISLAND FUDS
INVESTIGATION AREAS

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 01/16/2019

\\lovetonGIS\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\WorkPlan\Figure XX MRS-01 FUDS Investigation Areas.mxd

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QAPP Worksheet #12: Measurement Performance Criteria

This worksheet documents the project-specific measurement performance criteria (MPC) in terms of data quality indicators (DQI) (i.e., accuracy, sensitivity, representativeness, completeness, and comparability) for site characterization. MPCs are the minimum performance specifications that the remedial investigation must meet to ensure collected data will satisfy the DQOs documented on Worksheet #11 and are provided in the following tables.

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Table 12-1 Measurement Performance Criteria for the MEC Investigation

Measurement Performance Activity (DFW-Work Element-Sub-element)	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
Site Preparation (vegetation removal, if needed)	Completeness	Vegetation removal is enough to allow the use of the EM61-MK2 and MM 2x2.	Visually inspect grids.
Site Preparation (control points)	Accuracy	A professional land surveyor (PLS) will locate/establish two temporary control points for data positioning with the GPS base station. Control points will be accurate to 2 in.	Confirm that the survey control points have been accurately installed and properly labeled by PLS.
Site Preparation (mobilization)	Completeness	All staff and equipment mobilize to the site. Field personnel review documents and the SUXOS and UXOSO/UXOQCS provide site specific training to all field personnel.	Document qualifications, training records, onsite training logs.
Site Preparation (surface sweep)	Completeness	UXOQCS verifies that munitions and metallic debris have been removed from the survey areas. Site geophysicist compares MD/MEC findings to CSM and evaluates for inclusion in TOI library.	Visually inspect grids.
QA/QC Seeding	Representativeness	Blind QC seeds will be placed at the site by the contractor. Blind QC seeds must be detectable as defined by the DQOs and located throughout the horizontal and vertical survey boundaries defined in the DQOs. Blind QC seeds will be distributed such that the DGM field team can be expected to encounter at least one seed per day per team on average. Blind QA Validation seeds will be installed by USACE.	Review of Production Area QC Seeding Report.
Detection survey (DGM)	Completeness	100% of the planned survey areas are mapped with EM61-MK2 at required coverage. Areas not accessible by DGM must be annotated on DGM maps.	Verification of conformance to measurement quality objectives (MQOs) for in-line spacing and cross-line spacing.
Detection survey (DGM)	Sensitivity	A minimum detection threshold and SNR to detect a 1-pounder projectile lying horizontally at a depth of 1 ft within MRS-01. A minimum detection threshold and SNR to detect a 20-mm projectile lying horizontally at a depth of 6 in. along the shoreline or dump area. Threshold and SNR TBD following initial IVS.	Initial and ongoing IVS surveys. Blind QC and QA validation seed detection. Analysis of background variability across the site.
Detection survey (DGM)	Accuracy/Completeness	100% of the QC and validation seeds must be detected	Review of QC and validation seed detection results per survey unit.
Detection survey (DGM)	Completeness/Comparability	Complete project-specific databases and target lists delivered	Data verification/data validation
Classification Survey (AGC)	Accuracy/Precision/Completeness	An IVS will be established to validate that the DGM and AGC geophysical instrumentation is achieving detection performance metrics. It will remain in place and be used for twice daily testing during the AGC surveys.	Data verification/data validation.
Classification Survey (AGC)	Completeness/Comparability	Library must include signatures for all munitions known or suspected to be present at the site (if available), as listed in the CSM. Intrinsic parameters for items listed in the CSM not confirmed to be in existing libraries will be derived from test measurements prior to the start of the classification process (if the items are available) or the classification decision must include a method for correctly classifying any munitions not included in the library. Size, decay and symmetry parameters may be used to identify these munitions.	Verification of site-specific library.
Classification Survey (AGC)	Representativeness/Accuracy	Background data are collected at least once every hour of cued survey data collection. Background locations are selected such that background data will be representative of the various subsurface conditions expected to be encountered within each survey unit at the site.	Data verification/data validation.
Classification Survey (AGC)	Completeness	All detected anomalies classified as: • Priority 0 (cannot analyze) • Priority 1 (high confidence) TOI • Priority 2 (low confidence) TOI • Priority 3 non-TOI	Data verification.
Classification Survey (AGC)	Accuracy/Completeness	Cued survey must correctly classify 100% of all validation seeds.	Review of validation seed classification results.
Classification Survey (AGC)	Accuracy	100% of predicted non-TOIs that are intrusively investigated are confirmed to be non-TOIs.	Visual inspection of recovered items from classification validation.
Intrusive Investigation (classification validation – AGC)	Accuracy	Inversion results correctly predict one or more physical properties (e.g., size, symmetry, or wall thickness) of the recovered items (specific tests and test objectives established during project planning).	Visual inspection and qualitative evaluation of items recovered during classification validation.

Table 12-1 Measurement Performance Criteria for the MEC Investigation

Measurement Performance Activity (DFW-Work Element-Sub-element)	Data Quality Indicator (DQI)	Specification	Activity Used to Assess Performance
Underwater Transect Survey	Completeness/ Comparability	100% of the planned survey areas are surveyed with hand-held detectors at required coverage. Areas not accessible by underwater surveys must be annotated in the GIS.	Visually inspect dive operations.
Intrusive Investigation	Completeness/ Comparability	Complete project-specific database, including records reconciling inversion results to the physical properties of the recovered items.	Data verification/data validation.
Site Restoration/Demobilization	Completeness	All intrusive excavations have been filled in, all equipment/materials removed from site.	Visual inspection.

Notes:
The frequency of inspections is shown in Worksheet #22 for all applicable DFWs in this table.
AGC=Advanced geophysical classification
CSM=Conceptual site model
DGM=Digital geophysical mapping
DFW=Definable feature of work
DQI=Data quality indicator
DQO=Data quality objective
GIS=Geographic information systems
IVS=Instrument verification strip
MD=Munitions Debris
MEC=Munitions and explosives of concern
MM=Metal mapper
MRS=Munitions responses site
PLS=Professional Land Surveyor
QC=Quality Control
SUXOS=Senior UXO Supervisor
SWNR=Signal to noise ratio
TOI=Target of interest
UXO=Unexploded ordnance
UXOSO=UXO Safety Officer
UXOQCS=UXO Quality Control Specialist

QAPP Worksheet #13: Secondary Data Uses and Limitations

Data Type	Data Source (originating organization, report title, and date)	Data Generator(s)	How data may be used (if deemed usable during data assessment stage)	Factors affecting reliability of data and limitations on data use
Historical site information and munitions data	USACE, Potentially Hazardous Waste Site Preliminary Assessment No. C02NY0744, Iona Island Naval Ammunition Depot, Stony Point, New York, November 1992	Summary of site visit conducted on 30 October 1992.	Development of the CSM, including site history.	This information is considered valid.
Historical site information and munitions data	USACE, Inventory Project Report for DERP-FUDS Site no. C02NY0744, Iona Island Naval Ammunition Depot, Stony Point, New York, 1995	Description of CON/HTRW, HTRW, and Ordnance and Explosive Waste project categories at the Site.	Information on FUDS eligibility/ FUDS categories at the Site.	This information is considered valid.
Historical site information and munitions data	USACE, Archives Search Report Findings, Iona Island Naval Ammunition Depot, March 1998	Compilation of historical information to determine possible use or disposal of ordnance at the Site. Presented current and historical photographs and historical site layout drawings.	Development of the CSM, including site history and physical environment.	This information is considered valid.
Historical site information and munitions data	USACE, ASR Supplement, Iona Island Naval Ammunition Depot, November 2004	Documentation of historical use and ordnance items found at the Site.	Development of the CSM, including site history.	This information is considered valid.
Soil sampling and Munitions investigation data	Alion Science and Technology, Final Site Inspection Report for the Iona Island Naval Ammunition Depot, September 2008.	Investigation focusing on the 1903 explosion area to evaluate the presence of MEC or MC related to historical use of the Site and determine if the Site warranted further response action. The investigation included soil and sediment sampling for MC (explosives) and preparation of a MEC risk assessment.	Development of the CSM, including site history, physical environment, and potential exposure pathways. Previous soil and sediment sampling analytical results focusing on the 1903 explosion area to determine potential contaminants in the area.	This information is considered valid.

Data Type	Data Source (originating organization, report title, and date)	Data Generator(s)	How data may be used (if deemed usable during data assessment stage)	Factors affecting reliability of data and limitations on data use
Historical site information	U.S. Army Geospatial Center, Former Naval Ammunition Depot Iona Island, New York Historical Photographic Analysis, September 2018	Analysis of historical photographic records and historical map data relative to the Site. Presents historical drawings/maps/property plans from 1091 to 1965. Presents and analyzes aerial photographs from the early 1930s to present day.	Development of the CSM, including site history, site layout, former building/structure locations/usage, and current use.	This information is considered valid.

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

A summary of the MMRP project tasks is provided below and detailed descriptions of the DFWs are provided in Worksheet #17 – Sampling Design and Rationale. A general MMRP project schedule presenting the tasks and planned start and end dates is presented in Table 14-1. The schedule will be modified as necessary during the field activities based on weather or any access issues.

As noted in the Introduction, separate UFP-QAPPs will be implemented concurrently for the MMRP investigation and the HTRW investigation. A crosswalk between the MMRP and HTRW QAPPs is presented in Table 1. The schedule for the MMRP, shown as Table 14-1 and Table 1 (crosswalk summary) incorporates various planning and sequencing aspects of the RI. Different environmental time windows and locations that need to be integrated during field activities include 1) wintering bald eagle protections (approximately mid-December – mid-February; dependent on the winter weather season in the area) along the Hudson River shoreline of Iona Island and 2) the nesting/fledging of the least bittern (mid-April – mid-July) in the marsh grasses to the west of Iona Island. Field activities will be conducted on a schedule that avoids the key time periods and sensitive locations indicated for these species to the extent practicable. If work needs to be conducted during key time periods, additional coordination with Bear Mountain State Park POC will occur to allow access at the tail ends of these periods.

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Table 14-1 Project Schedule

DFW	Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
1	Pre-Mobilization Activities	EA/ANJV/AOR	Mon 2/17/2020	Mon 3/16/2020	GIS Database, Project Database	Mon 3/16/2020
2	Mobilization/Site Specific Training	EA/ANJV/AOR	Mon 3/16/2020	Tue 3/17/2020	SUXOS/UXOQCS daily logs	Tue 3/17/2020
2	Grid Stakeout	EA	Wed 3/18/2020	Thu 3/19/2020	SUXOS/UXOQCS daily logs	Thu 3/19/2020
2	Vegetation Removal	EA	Wed 3/18/2020	Thu 3/19/2020	SUXOS/UXOQCS daily logs	Thu 3/19/2020
2	Surface Clearance	EA	Wed 3/18/2020	Thu 3/19/2020	SUXOS/UXOQCS daily logs	Thu 3/19/2020
3	Blind Seeding	EA/USACE	Wed 3/18/2020	Thu 3/19/2020	Blind Seed Memorandum	Thu 3/26/2020
3	IVS Construction	EA/ANJV	Wed 3/18/2020	Thu 3/19/2020	IVS Memorandum	Mon 3/30/2020
4	DGM Sensor Assembly	ANJV	Wed 3/18/2020	Thu 3/19/2020	Instrument Assembly Checklist	Wed 4/22/2020
4	Initial DGM Instrument Verification Strip (IVS)	ANJV	Wed 3/18/2020	Thu 3/19/2020	IVS Memorandum	Thu 3/26/2020
5	DGM Survey	ANJV	Fri 3/20/2020	Thu 4/2/2020	Raw/Processed DGM data, Project Database	Wed 4/8/2020
5	DGM Data Processing/ Anomaly Selection	ANJV	Tue 3/24/2020	Mon 4/6/2020	Processed DGM data, Project Database	Mon 4/13/2020
5	DGM Data Validation	ANJV	Fri 3/27/2020	Tue 4/14/2020	Data Verification/ Validation Report	Tue 4/14/2020
6	Cued Sensor Assembly	ANJV	Tue 4/21/2020	Wed 4/22/2020	Instrument Assembly Checklist	Wed 4/22/2020
6	Initial Cued Instrument Verification Strip (IVS)	ANJV	Thu 4/23/2020	Thu 4/23/2020	IVS Memorandum	Thu 4/30/2020
7	Cued Survey	ANJV	Fri 4/24/2020	Thu 4/30/2020	Raw cued data, Project Database	Thu 5/7/2020
7	Cued Data Validation	ANJV	Fri 5/22/2020	Mon 6/22/2020	Data Verification/ Validation reports	Mon 6/22/2020
7	Cued Data Processing	ANJV	Fri 5/1/2020	Thu 5/14/2020	Processed cued data,	Thu 5/21/2020
7	Classify Cued Anomalies	ANJV	Fri 5/15/2020	Thu 5/21/2020	Final ranked dig list	Thu 5/21/2020
7	Cued Data Usability Assessment	ANJV	Fri 5/15/2020	Mon 6/22/2020	DUA	Mon 6/22/2020
8	Reacquire Cued and DGM TOIs	EA	Fri 8/14/2020	Tue 8/18/2020	Field logbooks, Project Database	Tue 8/18/2020
8	Intrusive Investigation of Cued and DGM TOIs	EA	Mon 8/17/2020	Fri 9/4/2020	Field logbooks, Project Database	Mon 9/7/2020
8	MPPEH Inspection, Verification, and Certification	EA	Mon 8/17/2020	Fri 9/4/2020	SUXOS/UXOQCS daily logs	Mon 9/7/2020
8	Demolition	EA	Mon 8/17/2020	Fri 9/4/2020	SUXOS/UXOQCS daily logs	Mon 9/7/2020
8	MDAS Disposal	EA	Mon 8/17/2020	Fri 9/4/2020	Form 1348-1, Certificate of Destruction, SUXOS/UXOQCS daily logs	Mon 9/7/2020
9	Underwater Investigation of Former Loading Docks	AOR	Mon 8/17/2020	Thu 8/27/2020	Dive Supervisor daily logs, Project Database	Fri 8/28/2020

Table 14-1 Project Schedule

DFW	Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
10	Cued Data Verification and Validation	ANJV	Mon 9/7/2020	Mon 8/14/2020	Data verification/ validation reports	Wed 10/7/2020
11	Post-Investigation VSP Analysis	EA	Mon 9/7/2020	Mon 9/7/2020	RI Report	Fri 1/22/2021
12	Final Data Usability Assessment	EA/ANJV	Mon 9/7/2020	Wed 10/7/2020	RI Report	Fri 1/22/2021
13	Site Restoration and Demobilization	EA/ANJV/AOR	Mon 9/7/2020	Tue 9/8/2020	SUXOS/UXOQCS daily logs	Tue 9/8/2020

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

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #17: Sampling Design and Rational

General Approach

The project objectives for the Iona Island Naval Ammunition Depot FUDS are to obtain data to sufficiently characterize the nature and extent of MEC and/or MC contamination present as a result of the MEC on site and to evaluate potential hazards related to the identified contamination. The general technical approach is based on the CSM for the site, described on Worksheet #10.

This worksheet describes the project design and the tasks that will be required to successfully complete field operations during this project and achieve the DQOs described on Worksheet #11. These DQOs include a design for obtaining data for both MEC and MC (if breached MEC is identified). The design for obtaining data described in the DQOs summarizes the technical approach for the investigation area, including land-based DGM surveys, land-based AGC surveys, intrusive investigations of anomalies on land, underwater investigations, and collection of environmental samples.

The field operations involve multiple elements, or "DFWs," that will be required to achieve the project goals. These DFWs are presented in Table 17-1 and they are explained further in this worksheet, with references to MPCs and other sections of the UFP-QAPP, as necessary. Note: At least two photographs of each DFW will be taken, documented in the logbook entry/field tablet, and included in the RI Report with a detailed caption.

An evaluation and analysis of historical information and previous investigations presented in Worksheet #10 concluded that potential MEC present at Iona Island include:

- MEC distributed throughout MRS-01 land, water, or marsh areas from the 1903 explosion at former Building Numbers 209 and 210

- DMM in the water at the former loading docks

- DMM along the shoreline in the vicinity of the two northern former loading docks (i.e. 50 ft to the north of the docks as well as 50 ft to the south)

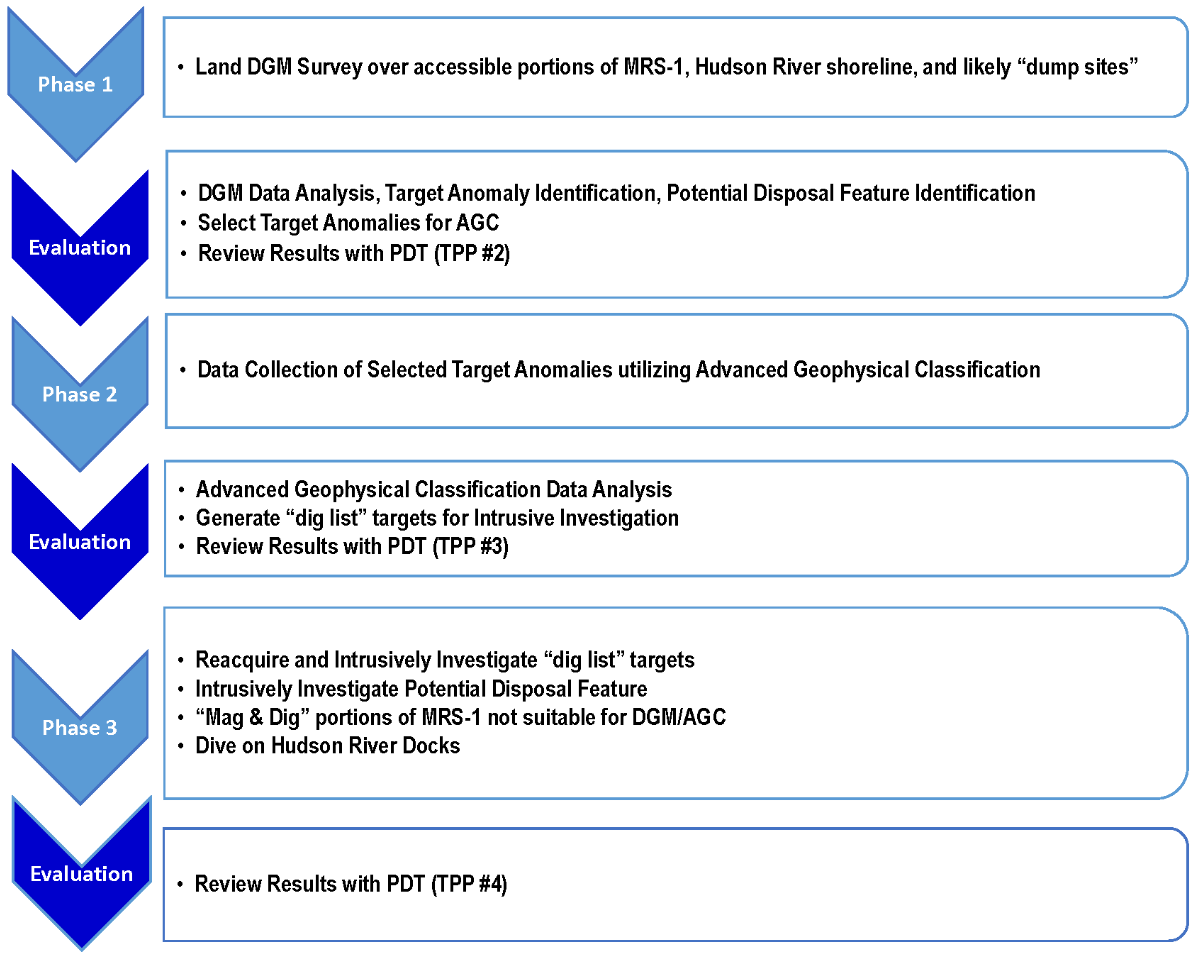
- DMM in the previously identified "dump site" between Iona Island and Round Island

The challenge of characterizing the nature and extent of potential MEC at the site is complicated by the fact that land, marsh, fill, and river environments are all present and require investigation—one approach will not meet the performance objects of the investigation. A multi-faceted and multi-phased approach using land-based DGM/AGC and hand-held analog magnetometers will be utilized to characterize the nature and extent of MEC. Intrusive investigations, on land and in water, will be used to confirm the presence and type of each TOI.

In the accessible marsh area, land-based DGM/AGC will be used in traversable areas of the marsh, and this data will be used to characterize the entire marsh and water), in terms of nature and extent.

A phased approach as shown in Figure 17-1 will be used to facilitate data collection and analysis, and communication and discussion with the PDT. Following each field effort, a meeting will be conducted to present data, detail any issues or changes to the CSM and describe the next phase of fieldwork.

Figure 17-1 MEC Phased Approach



MRS 1— During Phase I and Phase II, DGM and cued AGC will be conducted in grids throughout MRS-01 to characterize the nature and distribution of MEC from the 1903 explosion. Because the origin of the explosion is collocated with the debris from the ammunition depot buildings that have since been demolished, it is unlikely that DGM transects across the MRS to identify high anomaly density 'hot spots' that are solely related to the explosion will be successful. It will be more effective to collect 100% coverage DGM within a statistically significant number of grids throughout the MRS, then use cued AGC to identify MEC-like TOIs within these grids for intrusive investigation and filter out demolition-related construction debris.

The RI module of VSP v.7 (i.e., UXO Estimator equivalent) was utilized to determine the amount of DGM acreage and TOI investigation needed to calculate the probability of MEC contamination at the 95% confidence level. Iona Island is not a high public land use area because the site does not include beaches, schools, or residential areas. Based on the public use of the area (current and future), a "moderate public use" classification was selected for the MRS (0.5 UXO/acre) and DGM of approximately 6 acres with follow-on investigation of 100% of the DGM TOIs is necessary to characterize the 124.2-acre MRS. Phase 1 field efforts will include twenty-six 100-ft. by 100-ft. grids to characterize MRS-01 as shown in Figure 17-2. The twenty-six grids are randomly spaced for the VSP model to work; however, the grids are biased to avoid buildings, fill areas, bedrock outcrops, and areas where DGM may not be feasible based on analysis of aerial and topographic maps. If during installation of grids the area is found to be impractical for DGM and/or AGC, an attempt will be made to find a more suitable location nearby, but not so far that the randomness of VSP grid placement is compromised. The Site Geophysicist will inspect each grid following grid corner stakeout and assess the site conditions. If a grid is found to be unsuitable for DGM/AGC, the Site Geophysicist will attempt to find a more appropriate location nearby and notify the Project Geophysicist and USACE Geophysicist for concurrence on the new location. If a new location for the grid cannot be found, the grid will be designated as a "Mag and Dig" grid.

In areas where DGM and cued AGC are not practical in MRS-01, including heavily vegetated areas and other terrain that represent unsafe access to the equipment, and the grid cannot be relocated, the geophysical survey and intrusive investigation may be accomplished using handheld all-metal detectors (i.e., Mag and Dig). If during installation of grids the area is found to be impractical for DGM and/or AGC, an attempt will be made to find a more suitable location nearby, but not so far that the randomness of VSP grid placement is compromised. The Site Geophysicist will inspect each grid following grid corner stakeout and assess the site conditions. If a grid is found to be unsuitable for DGM/AGC, the Site Geophysicist will attempt to find a more appropriate location nearby and notify the Project Geophysicist and USACE Geophysicist for concurrence on the new location. If a new location for the grid cannot be found, the grid will be designated as a "Mag and Dig" grid.

Following DGM completed in Phase 1 and cued AGC in Phase 2, intrusive investigations will be performed on the AGC TOIs during Phase 3, including QA/QC targets. DGM (Phase 1) will be conducted in the summer, and at low tide when in the marshes and along the shoreline; cued AGC (Phase 2) will be conducted in the fall, and at low tide when in the marshes. Intrusive and dive operations will be conducted in the late spring/early summer. EA will not intrusively investigate AGC TOIs in the marsh unless PIPC grants permission for intrusive operations to be performed in the marsh. Instead, AGC analysis of the land and marsh grids, and intrusive results from the land-based grids, will be used to evaluate the marsh and determine the presence of MEC in the marsh without disturbing sensitive environments with intrusive operations.

Former Loading Docks**—**Underwater intrusive investigations will be utilized to characterize the area immediately around the former loading docks to identify targets that may be potential DMM from loading and unloading of supply vessels. UXO-qualified divers using hand-held underwater hand-held detectors will investigate the former loading dock areas by systematically traversing the area surrounding the concrete debris, as well as the general location of the former dock, if the debris was removed and the area is accessible. Dive operations will be performed along nominally spaced 10-ft transects over the former dock footprint, including and a 50-ft. buffer around the former dock footprint. Dives will be limited to 60 ft or where the river bottom exceeds 30 degrees slope or determined acceptable by Direct Person in Charge. Figures 17-3 and 17-4 show the former loading dock footprints and the underwater survey area.

EA evaluated the use of underwater DGM and concluded that the technology can be applied to this site, but underwater investigation using diver Mag and Dig techniques is likely to yield better results. The former loading docks were likely demolished in-place, fully or partially, based on the presence of concrete debris observed during the SI and the 2018 site visit. It is likely that this debris contains reinforcement rebar and; therefore, underwater DGM surveys around the loading docks will not likely yield useful data.

Shoreline In the Vicinity of Former Loading Docks—Land-based DGM will be performed along the Hudson River shoreline (land and shallow water) upstream, adjacent to, and downstream of the two northern former loading docks (i.e., 50 ft to the north of the docks as well as 50 ft to the south). DGM using an EM61-MK2 and RTK GPS will be performed along nominally spaced 10-ft transects parallel to the hightide shoreline within a 40-ft wide survey area along the shoreline. Note: Shallow water DGM transects will be a maximum of 20 ft from the hightide shoreline or 3 ft of water depth. Intrusive investigation will be performed on shoreline DGM TOIs using conventional, land-based intrusive techniques. Figure 17-5 shows the location of the shoreline investigation area.

Dump Site—DGM will be utilized to characterize the area identified from historical records as a "dump site" between Iona Island and Round Island to identify potential DMM. DGM using an EM61-MK2 and RTK GPS will be performed along tightly spaced transects (i.e., nominal 10-ft spacing) to identify potential disposal pits or trenches, or larger areas of general dumping. Intrusive investigation will be performed on DGM TOIs using conventional, land-based intrusive techniques, although mechanized earth-moving machinery (i.e., mini-excavator) may be used for larger disposal pits or trenches if these features are identified in the DGM data. If an inordinate number of DGM TOIs are identified in the dump site following the DGM survey, then AGC may be utilized to reduce the number of intrusive investigations. EA management will evaluate the dump site for number of TOIs and make recommendations to the PDT on whether to perform intrusive only activities or supplement the investigation with AGC. Figure 17-6 shows the location of the dump site investigation area.

Table 17-1 Definable Features of Work (DFW) and Associated Tasks

DFW	Associated Activities
1. Pre-Mobilization Activities	Prepare UFP-QAPP with APP, Site Safety and Health Plan (SSHP), including an Activity Hazard Analyses (Appendix B). USACE preparation of the ESP. Set up GIS. Participate in TPP process. Subcontracting.
2. Site Preparation	Mobilize staff, equipment, and supplies. Kickoff/Safety Meeting. Provide training to field personnel. Establish control points. Stake grids and transects. Surface sweep and clear debris from grids. Brush cutting in grids and along transects.
3. Establish IVS, Blind Seeding	Install IVS. Install blind seeds in DGM grids.
4. DGM Equipment Set Up and Testing	Assemble and test DGM equipment at IVS.
5. DGM Surveys	DGM of transects along shoreline. DGM of transects at the dump site. DGM of grids in MRS-01. Processing of DGM data. Target list for AGC and/or intrusive investigation.
6. AGC Equipment Set Up and Testing	Assemble and test AGC equipment at IVS.
7. Cued Surveys	Cued survey of DGM anomalies in MRS-01 using AGC equipment. Processing/analysis of cued data. Target list for intrusive investigation. Data usability assessment.
8. Intrusive Investigation	Reacquire and intrusively investigate DGM TOIs along shoreline and in dump site. Reacquire and intrusively investigate AGC TOIs in MRS-01. Mag and Dig grids not suitable for DGM in MRS-01. MPPEH Inspection, Verification, and Certification. Demolition of MEC. Dispose of material documented as safe (MDAS).
9. Underwater Intrusive Investigation	Reacquire geophysical anomalies selected for intrusive investigation. Investigate geophysical anomalies selected for reacquisition. MPPEH Inspection, Verification, and Certification. Demolition of MEC. Dispose of MDAS.

DFW	Associated Activities
11. Cued Data Threshold Verification and Data Classification Validation	Check all data collection, analysis activities completed and documented. Validate data as conforming to SOPs and MPCs
12. Post Intrusive VSP Analysis	Use VSP to create MEC, MD, and anomaly density maps for MRS-01, former loading docks, shoreline, and the dump site with intent to define lateral extent of MEC. Determine if NCMUA determination for MRS-1 is valid.
13. Final Data Usability Assessment	Review project data requirements (data, completeness, and archiving). Verify accuracy of the project database. Verify the DQOs were met.
14. Site Restoration and Demobilization	Restore excavations, demobilize personnel and equipment.

DFW 1: Pre-Mobilization Activities

GIS and Project Database—A project GIS will be established, and all relevant geospatial-related data and information will be contained in the GIS. For GIS information that is collected from other sources, EA will incorporate the Government-provided GIS information as is practical in defining the project's existing conditions.

EA will incorporate layers that overlay on maps of the site that identify physical features, and MEC, MD, and Range-Related Debris found during the investigation. Examples include streets, anomalies, MEC positively identified, identifiable MD, depth of MEC and MD, sampling locations, and cultural resources.

The horizontal accuracy of GIS data created by EA will be tested IAW the National Standard for Spatial Data Accuracy, and the results will be recorded in the metadata. The geodatabase shall be a living repository that is refined throughout the life of the project. GIS data management is discussed further in Worksheet #29.

In addition, a Microsoft Access project database will be established to contain all DGM and intrusive data. Information pertaining to all transect data collected during DGM surveys will be stored in the project database. The database(s) will be maintained throughout the duration of the project and will contain records of all instrument standardization tests conducted each day as well as the results of QC checks made on all processed data. Note: At the conclusion of the project the geophysical data (native electronic format and pdf) will be uploaded into FUDSChem.

DFW 2: Site Preparation

EA will conduct activities to prepare the site as well as any areas needed for equipment ingress/egress. Site preparation activities include site specific training on the UFP-QAPP and APP/SSHP, grid and transect stakeout, surface sweep of grids and debris removal, and vegetation removal in grids, as necessary.

Mobilization (personnel/equipment)—The mobilization period will include mobilizing staff and securing and deploying equipment. Additional mobilization activities include:

- Coordinate with local agencies, including PIPC / Bear Mountain State Park, local hospital, nearest hyperbaric chamber, and fire department, as appropriate.
- Test and inspect equipment upon arrival.
- Coordinate with PIPC / Bear Mountain State Park to site equipment storage box, if needed and site toilets (in area accessible to the work area).
- Coordinate with CSX Transportation to perform RI activities along the River Subdivision railroad line.
- Verify that all forms and project documentation are in order and project team members understand their responsibilities regarding completion of project reporting requirements.

Site Specific Training—A field kickoff meeting will be conducted prior to initiating Mobilization I RI field activities to provide site-specific training to the field personnel. The field kickoff meeting will include the USACE Ordnance and Explosives Safety Specialist (OESS), EA, and relevant subcontractors that will be implementing the fieldwork (i.e., ANJV, AOR), and PIPC / Bear Mountain State Park (to assist with natural resource and cultural resource awareness training).

During the site-specific training, the field team will review the following:

- Project plans (i.e., UFP-QAPP, APP/SSHP and Dive Operations Work Plan)
- PIPC / Bear Mountain State Park expectations and code of conduct for the field team during RI activities
- Site hazards/site safety and health concerns evacuation plans and procedures/route to the hospital
- Safety procedures
- Procedures to be employed to minimize environmental impacts
- Ways to identify natural or cultural resources
- Procedures to be employed if/when natural or cultural resources are identified. An Environmental Protection Plan (EPP) is provided in Appendix C.

Grid and Transect Stakeout—EA plans to use the existing land survey control points for data positioning. However, if the field team is unable to recover and utilize the existing control points or needs additional control points to assist in the RI, a Professional Land Surveyor (PLS) will be used to establish two new control points. The PLS will use either a Trimble Global Navigation Satellite System real-time kinematic (RTK) GPS unit (or equivalent) or a conventional survey system (e.g., total-station) to perform survey work. A qualified UXO Technician will escort the PLS and check the locations where wooden stakes and rebar are to be inserted bgs using a Schonstedt GA-52cx metal detector (or equivalent) to ensure that a metallic item is not present at the location.

Navigational data will be correlated with horizontal control based upon a local Third Order (1:5,000) or better, monument or survey marker. Vertical survey data will be provided in North American Datum 1988 and horizontal survey data will be provided in WGS84 Universal Transverse Mercator Zone 18N, in units of meters. The New York registered PLS, if needed, will document compliance with all accuracy specifications.

The location, identification, coordinates, and elevations of all control points that are recovered and/or established at the site will be plotted on one or more site maps. Each control point will be identified on the map by its name and number and the final adjusted coordinates.

EA personnel will stakeout 100-ft by 100-ft grids in MRS-01 1903 Explosion Area and transect endpoints along the shoreline and in the dump site for use by field personnel. All survey files and field notes will reference the grid/transect nomenclature, as appropriate. In order to stakeout the land-based survey grids, EA personnel including a UXO Technician will use a Trimble R8 RTK GPS (or equivalent) to mark the grid corners. Staking of all control points and points of interest will be accomplished by driving wooden stakes for temporary markers to be removed when field activities are completed. The UXO Technician will use a Schonstedt GA52Cx magnetometer, or similar, to scan the location in advance of stake placement. Detailed procedures are contained in MR SOP 004. The list of grids IDs and grid corner coordinates is presented in Table 17-2.

***Surface Sweep*—**The instrument-assisted UXO Clearance teams will place rope at intervals that do not exceed 10 ft wide for the identification of lanes. Each UXO team member will sweep his/her lane with the analog hand-held Electromagnetic Induction (EMI) or all-metals detector in 5-ft-wide intervals requiring each 10-ft lane to be swept twice. The surface clearance will be required to identify and safely remove all MEC/MPPEH, MD, and non-munitions related debris from the surface that are 0.75 in. by 2.5 in. in size/shape or larger. Detailed procedures are contained in MR SOP 004. Any MPPEH discovered during the surface sweep will be handled as described in DFW 8 Intrusive Investigations.

***Vegetation Removal*—**With approval from PIPC / Bear Mountain State Park, vegetation will be removed from DGM transects and grids, as needed, to allow equipment to pass through and perform the DGM survey. Vegetation removal will be kept to a minimum. The PIPC / Bear Mountain State Park will provide guidance on the vegetation removal process and will indicate where vegetation may or may not be removed. Transects and grid locations may be adjusted in the field to circumvent sensitive areas as identified by PIPC / Bear Mountain State Park to prevent unnecessary disturbance of natural resources. Detailed procedures are contained in MR SOP 004.

Table 17-2 Grid Corner Coordinates

Grid ID	Corner	Easting	Northing	Grid ID	Corner	Easting	Northing
1	NW	585465.30	4572718.00	14	SE	585679.21	4572900.33
1	NE	585495.80	4572718.00	14	SW	585648.73	4572900.33
1	SE	585496.00	4572687.00	15	NW	585807.40	4572754.45
1	SW	585465.50	4572687.00	15	NE	585837.88	4572754.45
2	NW	585724.01	4572888.55	15	SE	585837.88	4572723.97
2	NE	585754.49	4572888.55	15	SW	585807.40	4572723.97
2	SE	585754.49	4572858.07	16	NW	585602.94	4573049.76
2	SW	585724.01	4572858.07	16	NE	585633.42	4573049.76
3	NW	585556.02	4573168.20	16	SE	585633.42	4573019.28
3	NE	585586.50	4573168.20	16	SW	585602.94	4573019.28
3	SE	585586.50	4573137.72	17	NW	585758.30	4572522.00
3	SW	585556.02	4573137.72	17	NE	585788.80	4572522.00
4	NW	585913.81	4573046.10	17	SE	585788.80	4572492.00
4	NE	585944.29	4573046.10	17	SW	585758.30	4572492.00
4	SE	585944.29	4573015.62	18	NW	585847.34	4572934.95
4	SW	585913.81	4573015.62	18	NE	585877.82	4572934.95
5	NW	585662.20	4572567.00	18	SE	585877.82	4572904.47
5	NE	585692.70	4572567.00	18	SW	585847.34	4572904.47
5	SE	585692.70	4572536.00	19	NW	585626.20	4573140.88
5	SW	585662.20	4572536.00	19	NE	585656.68	4573140.88
6	NW	585992.11	4572828.37	19	SE	585656.68	4573110.40
6	NE	586022.59	4572828.37	19	SW	585626.20	4573110.40
6	SE	586022.59	4572797.89	20	NW	586003.56	4572722.63
6	SW	585992.11	4572797.89	20	NE	586034.04	4572722.63
7	NW	585580.05	4572917.59	20	SE	586034.04	4572692.15
7	NE	585610.53	4572917.59	20	SW	586003.56	4572692.15
7	SE	585610.53	4572887.11	21	NW	585395.30	4573013.00
7	SW	585580.05	4572887.11	21	NE	585425.80	4573013.00
8	NW	585401.10	4572854.00	21	SE	585425.80	4572983.00
8	NE	585431.60	4572854.00	21	SW	585395.30	4572983.00
8	SE	585431.60	4572824.00	22	NW	585809.76	4573224.51
8	SW	585401.10	4572824.00	22	NE	585809.76	4573254.99
9	NW	585855.98	4573024.67	22	SE	585840.24	4573254.99
9	NE	585886.46	4573024.67	22	SW	585840.24	4573224.51
9	SE	585886.46	4572994.19	23	NW	585957.77	4572762.28
9	SW	585855.98	4572994.19	23	NE	585988.25	4572762.28
10	NW	585740.30	4573020.02	23	SE	585988.25	4572731.80

Grid ID	Corner	Easting	Northing	Grid ID	Corner	Easting	Northing
10	NE	585770.78	4573020.02	23	SW	585957.77	4572731.80
10	SE	585770.78	4572989.54	24	NW	585499.93	4573029.94
10	SW	585740.30	4572989.54	24	NE	585530.41	4573029.94
11	NW	585861.95	4572837.93	24	SE	585530.41	4572999.46
11	NE	585892.43	4572837.93	24	SW	585499.93	4572999.46
11	SE	585892.43	4572807.45	22	NW	585868.17	4573103.82
11	SW	585861.95	4572807.45	22	NE	585868.17	4573073.34
12	NW	585456.30	4573117.16	22	SE	585837.69	4573073.34
12	NE	585486.78	4573117.16	22	SW	585837.69	4573103.82
12	SE	585486.78	4573086.68	25	NW	585779.01	4572932.36
12	SW	585456.30	4573086.68	25	NE	585809.49	4572932.54
13	NW	585831.87	4572663.15	25	SE	585809.66	4572902.07
13	NE	585862.35	4572663.15	25	SW	585779.19	4572901.89
13	SE	585862.35	4572632.67	26	NW	585730.37	4573128.51
13	SW	585831.87	4572632.67	26	NE	585760.85	4573128.51
14	NW	585648.73	4572930.81	26	SE	585760.85	4573098.03
14	NE	585679.21	4572930.81	26	SW	585730.37	4573098.03

DFW 3: Establish IVS, Blind Seeding

IVS Construction—An IVS will be established adjacent to or within the MRS for DGM and AGC system testing and verification prior to use for dynamic and cued surveys, respectively. The IVS will be in an area that is representative of the terrain, vegetation, and underlying rock and/or soils that naturally exist within the principal survey area. A background survey will be conducted in a proposed site for the IVS to determine whether native anomalies that would interfere with the responses of IVS seed items are present. The IVS will be established as described in ANJV SOP-2. Seed items to be used in the IVS will consist of small and medium industry standard objects (ISOs). The ISOs are used because they are inert, manufactured to precise specifications, and their responses are well documented. Instrument response curves for the ISOs have been developed by the Naval Research Laboratory demonstrating their standard response under their most favorable orientation (perpendicular to the EM61 transmit plane; i.e., buried vertically in the ground surface) and least favorable orientation (parallel to the transmit plane; i.e., buried horizontally and perpendicular to the direction of travel with the EM61) for a range of distances from the instrument's bottom transmit/receive coil (Naval Research Laboratory 2008). In total, three items will be placed in the IVS, with each item separated by at least three meters to ensure no response overlap. Items will be placed at the depths shown in Table 17-3, with the intent of ensuring an SNR of at least 6.

The IVS will be surveyed twice daily (morning and end of day) for each day of DGM. Data will be processed and checked for compliance with the DQOs for the IVS and for other QC measures. All QC failures will be reported to USACE. A Root Cause Analysis (RCA) will be performed to find the source of any QC failure and to determine the extent of work that may be affected by the failure. CAs will be implemented, and re-work performed as necessary.

Table 17-3 IVS Item Types, Depths, and Orientation

Item	Type	Depth (ft) (measured to center of mass)	Orientation
1	Small ISO	0.5	Horizontal, perpendicular to IVS transect centerline
2	Small ISO	0.5	Vertical
5	Medium ISO	1.0	Horizontal, perpendicular to IVS transect centerline

***Blind Seeding*—**The blind seeds will be placed in the subsurface by the QC Geophysicist (assisted by a UXO Technician II for anomaly avoidance) IAW ANJV SOP 3. The blind seeds will be comprised of both small (1-in. by 4 in.) and medium (2 in. by 8 in.) ISOs (i.e., steel pipes). The total quantity of subsurface blind seeds placed will ensure that, on average, each DGM or AGC field team will encounter one seed per field day. Subsurface QC seeds will be placed with their center of mass at depths at which they will cause a response resulting in an SNR of at least 6, regardless of where they pass under the footprint of the detection systems. Planned depths of burial are shown in Table 17-4 for each of the anticipated blind seed items. Final as-built information on the seeds will be documented and provided upon completion in a Blind Seeding Technical Memorandum. A "firewall" to prevent the seed locations from being discovered by the field crews or processing geophysicist will be established IAW the Blind Seed Firewall Plan presented in ANJV SOP 3.

Table 17-4 Maximum Burial Depth of Subsurface QC Seed Items

QC Seed Item	Max. Depth (ft)
Medium ISO	1.0
Small ISO (80)	0.5

DFW 4: DGM Equipment Set Up and Testing

The EM61 system will be used in IAW ANJV SOP DGM-01. Assembly details will be included in the Dynamic IVS Technical Memorandum.

To test the EM61 system and verify proper functionality, an initial dynamic IVS survey will be performed. After performance of the initial dynamic IVS, the Dynamic IVS Technical Memorandum will be prepared detailing the IVS setup, surveys, and results, including documentation of compliance with the dynamic IVS MQOs provided in Worksheet #22. The Dynamic IVS Technical Memorandum will be provided to the project team for review and concurrence. An addendum will be prepared for each additional IVS location established, if any, detailing the IVS setup and initial survey results for review and concurrence.

If an instrument fails to meet IVS MQOs established in Worksheet #22 the nonconformance/RCA/CA process will be implemented to determine the root cause and appropriate CA(s).

DFW 5: DGM Surveys

***Conduct DGM detection survey*—**After performance of the initial dynamic IVS, dynamic EM61 data will be collected within grids and along transects to identify the locations of metallic objects in the subsurface. The dynamic detection survey will be performed as described in ANJV SOP DGM-01. The EM61-MK2 and RTK GPS will be operated on wheels with the coils oriented with the 1-meter axis perpendicular to the line direction during land-based surveys. For the survey in the shallow water along the shoreline, the EM61-MK2 and RTK-GPS will be hand-carried or floated on a raft depending on shoreline sediment conditions. Geophysical and local positional data will be logged in an Allegro CX handheld computer. Within grids, EM61 survey data will be collected along parallel lines nominally spaced 0.5-meters apart. The geophysical instruments will undergo daily functional checks, as described in Worksheet #22 and the SOPs, as a means of reviewing and documenting system performance.

Moving from the detection phase to the cued interrogation and classification phase requires successful detection and selection of geophysical anomalies of QC and validation (QA) seeds. If any of these seeds are not detected and selected, work will be stopped, and the nonconformance/RCA/CA process will be implemented to determine the root cause and appropriate CA(s).

***Conduct data processing and document locations of anomalies*—**The dynamic EM61 data will be processed as described in ANJV SOP DGM-02. Anomalies identified for cued interrogation will be selected from the data using the response amplitude approach, where anomalies above the designated SNR threshold are assumed to be potential TOIs. In addition, potential background locations will be identified from the dynamic response data for use during the cued survey phase. Sensor noise levels within the survey areas will be evaluated to determine the extent to which the TOI can be reliably detected. Noise levels will be evaluated by calculating the root mean square of sensor data collected over areas devoid of anomalies. In addition to the SNR threshold, other components of the geophysical data will also be considered when evaluating anomalies for inclusion on the final target list. Each selected anomaly will also be analyzed for proper decay across the four-time gates, meaning that CH4<CH3<CH2<CH1. Anomalies whose responses do not decay in this manner will be flagged for review to determine whether they will remain on the final target list. Additionally, anomalies caused by known cultural features, such as utilities or surface structures, will be documented and removed from the Amplitude Response Anomaly List.

The Dynamic Data Analysis and Target Selection Technical Memorandum will include a summary of the dynamic data processing and anomaly selection approach, as well as the Amplitude Response Anomaly List. The Dynamic Data Analysis and Target Selection Technical Memorandum will also identify potential background locations for use during the cued survey, a summary of survey area coverage and relative anomaly density, and stipulate whether the MQOs have been met thus far. If a portion of the study area is determined to have an anomaly density too high for cued interrogation of individual anomalies, then an alternative approach for these areas will be proposed to the project team as part of the Dynamic Data Analysis and Target Selection Technical Memorandum.

Data Validation—Data validation will be performed IAW Worksheet #35. Moving from the detection phase to the cued interrogation and classification phase requires successful detection and selection of geophysical anomalies representing QC and validation (QA) seeds. If any of these seeds are not detected and selected or other MQOs identified in Worksheet #22 are not achieved, the nonconformance/RCA/CA process will be implemented.

DFW 6: AGC Equipment Set Up and Testing

ANJV will perform AGC cued interrogation surveys using advanced EMI systems, including a Geometrics MetalMapper 2x2 system. All ANJV personnel will have previously completed ANJV Internal Demonstration of Capability (ANJV SOP 12). The systems will be assembled as described in ANJV SOP 1MM2.

After setup of the system for cued surveys, the IVS will be used to perform an initial cued IVS with that system IAW ANJV SOP 2 to confirm that it is set up and functioning properly. Initial function tests and cued IVS results will serve as baselines with which daily tests will be compared, as described in ANJV SOP 2.

After performance of the initial cued IVS, a Cued IVS Technical Memorandum will be prepared detailing the cued IVS surveys and results, including documentation of compliance with the cued IVS MQOs provided in Worksheet #22. This memorandum will be provided to USACE for review and concurrence.

DFW 7: Cued Surveys

Cued Survey Data Acquisition—Before conducting cued surveys, the background locations identified during the dynamic data processing will be processed and checked for usability as a background location IAW ANJV SOP 6. The background locations that pass the Background Validation test in UX-Analyze will be marked in the field using vinyl-stem surveyor flags. The background location identification (ID) will be written in indelible marker on the surveyor flag.

Anomalies identified for cued interrogation will be reacquired in real-time with the advanced EMI system combined with RTK-GPS. The field operator will select anomaly IDs for reacquisition through the advanced EMI system software interface. Once cued interrogation begins, the anomaly ID will be automatically stored in the associated advanced EMI system data file and the target will be removed from the reacquisition list.

Validate advanced sensor data—After the cued data are downloaded from the data acquisition computer, the data processor will review the dataset to validate that it meets the MQOs listed on Worksheet #22. If an MQO is not met, the nonconformance/RCA/CA process will be implemented.

Cued Data Processing**—**ANJV will process the advanced EMI system data IAW ANJV SOP 8. The classification process considers how well the signature matches the library data to produce a metric that will be used to create a ranked dig list. However, some targets may be classified as digs at the analyst's discretion regardless of library match metric. This can occur if the signature does not match library data but appears to either (1) fit that of a cluster (i.e., numerous similar signatures consistent with a potential TOI not contained in the library) or (2) predict properties consistent with those of a munition. ANJV will use information in the CSM (e.g., site history and uses, and known types and distribution of munitions) to assist with the classification process. Justification will be provided for any analyst-added digs.

Site-specific libraries consisting of polarizabilities from the DoD Advanced Classification Library will be developed. Additionally, the library can be modified using test pit data collected over site-specific munitions, if inert examples can be procured, or with project data if the results of training digs indicate items need to be added to or removed from the library.

Classify anomalies and make dig/no-dig decisions-Objects will be classified into one of the following categories:

- Priority 0 (cannot analyze)
- Priority 1 (high confidence) TOI
- Priority 2 (low confidence) TOI
- Priority 3 non-TOI.

All TOI listed as Priority 0, 1, and 2 will be excavated. Approximately 50 category 3 sources will be excavated. USACE will review the classification results about the validation seeds, if any, and other pertinent validation data prior to acceptance. Changes may be made to the classifier used and the dig list as necessary, prior to acceptance. The processed data, including processing notes and supporting classification images; project database, and ranked dig list will be provided. The results of QC checks will be summarized in the project QC database and weekly QC Reports.

Data Usability Assessment (Cued Phase)**—**Upon completion of the data processing and classification, a cued survey DUA will be completed using the three-step process described in Worksheet #37 which requires review and acceptance by USACE. At this point USACE will also select classification validation targets, if desired. These validation targets will be selected from those classified as non-TOI and will be used during the cued data validation stage. The cued data must be determined to be usable prior to proceeding to the intrusive investigation phase. Usability will be based on achievement of DQOs and MPCs. The cued survey DUA report will be submitted 30 days following completion of data collection.

DFW 8: Intrusive Investigation

Anomaly Reacquisition**—**Anomalies selected for intrusive investigation will be reacquired using an RTK GPS. Flags will be placed at the location derived through the data processing and classification process (also known as the "fit" location). The anomaly ID will be written in indelible marker on a surveyor flag placed at the anomaly location. Additionally, surveyor paint may be used to spray the location if the field team has concerns that the survey flags may be windswept out of place. Detailed procedures are contained in MR SOP 070.

Anomaly Excavation—Anomalies identified for intrusive investigation will be excavated by UXO-qualified personnel IAW MR SOP 005 and 014. The intrusive investigation team will include a UXO Technician III (Team Leader) and three, 2-person dig pairs. Each dig pair be comprised of a UXO Technician II and a UXO Technician I. UXO personnel will be under the direction of the SUXOS. When the team occupies the position, the target is checked using a Schonstedt GA-52cx or similar magnetometer to confirm its exact location. Each DGM target location is searched to a maximum 2.5-ft radius of the original position. For AGC targets, the search radius is 1 ft. If the anomaly cannot be identified, the location will be excavated to a depth of 2 ft and rechecked. If the anomaly is still not identified, the location will be marked as “no contact.”

For each target anomaly finding, the teams will record the following information:

- Standard official nomenclature (if possible)
- Item description (e.g., UXO, DMM, MD, size)
- Condition of the item (e.g., fuzed, unfuzed)
- Weight of item
- Depth recovered
- Location coordinates using GPS
- Multiple items associated with the same target anomaly will be documented individually
- Digital photograph(s) taken of each MEC/MPPEH item (side, bottom and top views) and of representative MD

The UXO Team Leader will check each excavation to ensure that all metallic items larger than a 20-mm projectile have been removed from the target location. Each anomaly investigation is complete when:

- There is no remnant analog response with a handheld magnetometer.
- The excavation has been identified and verified by UXOQCS as saturated with fragmentation and no metal larger than a 20-mm projectile remains.

- It is identified and verified by UXOQCS as NMRD or construction material that cannot reasonably be removed.

- Hand tools have been used to the maximum extent practicable (assumed to be approximately 4 ft bgs) and single anomalies cannot be accessed (i.e., due to depth or hole collapse).

In shallow waters (i.e., shoreline, wetland/marsh, etc.) engineering controls may be used during intrusive investigation activities to dewater areas and provide adequate visibility where anomalies are being investigated. Engineering controls may include, but are not limited, to coffer dams, sandbagging, and/or water pumps for dewatering. If the field team is unable to safely investigate an anomaly due to visibility, the intrusive investigation will be terminated and USACE will be consulted to determine an alternate course of action and to coordinate with/notify the appropriate agencies (i.e. National Oceanic and Atmospheric Administration/U.S. Fish and Wildlife Service).

If a munitions disposal pit is identified during intrusive investigation operations on land, the UXO team will document the location and record the types of items disposed of in the pit. The UXO team will determine the vertical extent by excavating alongside the disposal pit to the maximum extent practicable using mechanized EMM (i.e. mini-excavator). The intrusive investigation may be terminated at any time due to safety concerns (i.e., depth/stability of excavation, water intrusion, reduced visibility, etc.). The horizontal extent of the disposal area will be evaluated using the DGM data. MEC will be disposed of the same day found unless weather or delivery of explosives prevents disposal operations.

All materials discovered during intrusive investigations are considered MPPEH until determined otherwise. MPPEH determined to be acceptable-to-move by the SUXOS and UXOSO will be recovered, temporarily stored in the explosive storage magazine, and disposed of at the completion of field activities or when appropriate through the course of the investigation. MPPEH is to be inspected, documented and segregated into two categories: material determined an explosive hazard (MDEH) or MDAS (after certification/verification by the SUXOS and UXOQCS, respectively) or remain MPPEH until disposal within the MRS or explosive venting. NMRD will be inspected and will not be comingled with MDAS, MEC or MPPEH.

Minimum separation distances (MSD) are determined IAW the final DDESB-approved Explosives Site Plan (ESP) (Appendix D). As indicated in the ESP, the hazardous fragment distance (HFD) for non-essential personnel is based on an unintentional detonation. This HFD will be the exclusion zone around work areas when intrusive investigation work is being performed. The UXOSO will establish the exclusion zone around the work area (which may include multiple DGM anomaly locations).

Any required evacuations will be coordinated through PIPC / Bear Mountain State Park after conferring with the USACE OESS. Any occupied buildings or public roadways within the MSD areas during MEC operations will be evacuated (or work rescheduled) and/or roadways blocked to prevent non-essential and unauthorized personnel from entering the work areas during the performance of MEC operations. Work will halt while trains pass by. In the event a building cannot be evacuated during typical field hours, work within the minimum separation distance of the building will be accomplished on a non-work day for the building, or if the building is continually occupied the field team will work with the personnel and the field team will apply the necessary engineering controls to shelter in place. If the roadway cannot be blocked, spotters will be used to alert the UXO teams to cease operations until non-essential personnel are outside the MSD.

MPPEH Inspection, Verification, and Certification—During the course of this project, munitions-related items may be recovered during the field investigations. Munitions related items will be inspected according to the three-step inspection process and if determined to be MPPEH, will be further identified as MEC, MDEH, or MDAS. MDAS is certified and verified IAW MR SOP 006.

All MPPEH will be handled in compliance with DoD Instruction 4140.62 (DoD 2018) and EM 385-1-97 (USACE 2013). Recovered MD or range-related debris items will be considered MPPEH until the item is visually inspected by a UXO-Qualified Technician (Field Team Leader – UXO Technician III). Recovered items will be visually inspected twice for the presence of explosive or other hazardous material. Initial inspection occurs in the field by the UXO Technician discovering the item, followed by that of the Field Team Leader, who will re-inspect at the end of the day for the presence of explosives or other hazardous materials. The disposition of MPPEH will be determined accordingly based upon the following categories after inspection:

- MDEH: The explosive hazards are known or suspected and documented. These items will be disposed of by detonation IAW MR SOP 009 and the ESP.

- MDAS: Not presenting an explosive hazard, and consequently safe for unrestricted transfer or release. This is no longer considered MPPEH (upon final inspection and certification) and is disposed of IAW MR SOP 006.

EA will maintain a detailed account of the MPPEH encountered. The UXO personnel will record identification data of MPPEH, including amounts, nomenclature, condition, location, depth, and disposition; these will be included in the RI Report.

Demolition—For an item to be identified as MEC, it will be positively identified as such by two qualified UXO technicians (i.e., a UXO Technician III or above). If MEC are identified during field activities, the UXO teams will stop work at that location, mark the location with two crossed red marker flags, record the GPS coordinates, and notify the SUXOS who will initiate the notification procedures described in the APP (Appendix B). The SUXOS will notify USACE OESS, PIPC / Bear Mountain State Park, and the EA PM that a MEC item has been located. At that time, a determination will be made by onsite management as to the final disposition.

MEC identified during the RI may be moved within the MRS only if the items are deemed acceptable-to-move by the SUXOS and UXOSO. MEC that is acceptable-to-move may be consolidated to one collection point within the FUDS prior to conducting individual demolition shots using engineering controls. Donor explosives will be brought onsite on an as-needed basis from a local vendor. If MEC are encountered that are acceptable-to-move, items will be consolidated prior to demolition. Explosives will be managed IAW the Explosives Management Plan provided in Appendix D.

Prior to initiation of demolition operations, all non-essential personnel will be evacuated from the detonation site. Prior to priming the demolition charges, EA guard personnel will physically block all avenues of ingress. Radio communications will always be maintained between all involved parties. Avenues of ingress will not be opened without the express permission of the EA SUXOS. A constant state of vigilance will be maintained by all personnel to detect any intrusion into the fragmentation zone. EA will use engineering controls (i.e., Buried Explosion Module, sandbag mitigation) IAW the approved ESP (Appendix E), DDESB Technical Paper 16 (DDESB 2012) and the fragmentation database, whenever it is necessary to dispose of items by demolition, in order to reduce the fragmentation distance where an acceptable fragmentation distance cannot be achieved.

Upon completion of disposal operations, the UXO Technician III and one additional qualified person will perform a visual inspection of the disposal site(s) and give the all clear. An additional UXO Technician II or above will stand by at a safe distance and is prepared to render assistance in the event of an emergency. Upon completion of this inspection and if there are no residual hazards, the SUXOS will authorize the resumption of site operations.

***MDAS Disposal*—**If an MPPEH item is determined not to present an explosive hazard (after inspection by the SUXOS and UXOQCS), and does not pose an explosive hazard, the item will be reclassified as MDAS and secured in a locked container. An onsite storage container will be used to ensure the integrity of the chain-of-custody of the MDAS and will be safeguarded under lock and key. The onsite storage container (i.e., trailer or Conex box) will remain locked when not in use. Inspection, documentation, security, transfer and disposal of MDAS will be IAW EM 385-1-97 (USACE 2013) and MR SOP 006.

Prior to release, DoD DD Form 1348-1 will be signed by the certifier (SUXOS) and verified by the UXOQCS. The following certification/verification statement will be entered on each DD 1348-1A:

“This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials.”

After Form 1348-1 document is signed by the SUXOS and verified by the UXOQCS a copy will accompany the MDAS to its final disposition. The MDAS will be shipped to American EOD Services, a recycling facility, at the end of each mobilization phase. All turn-in documents for MDAS (i.e., Form 1348-1 and Certificate of Destruction) will be submitted with the RI Report.

DFW 9: Underwater Intrusive Investigation

The five-person dive team will include a boat coxswain, Direct Person in Charge (DPIC)/Dive Supervisor (marine SUXOS), one diver, one standby diver, and one tender. AOR’s UXO-qualified dive team will investigate pre-determined transects. Each former pier location will be investigated using underwater EMI detectors on 10-foot transects and select locations along the shoreline. Dives will be limited to 60 ft or where the river bottom is less than 20 degrees slope or determined acceptable by the DPIC/Dive Supervisor.

Diving will be completed in Surface Supplied Dive Mode. Each diver will be equipped with an Emergency Gas Supply (EGS), a Shark Marine Navigation Tablet, and an Underwater Ebinger 725K analog detector fitted with a 230 mm coil (or similar detector). Transects of each loading dock area will be pre-loaded into the Shark Marine Navigation Tablet prior to diving operations. The tablet will be connected to a global navigation satellite system (GNSS) buoy for locating and tracking divers along transects. The GNSS GPS will be tested daily to ensure the positioning systems are functioning as designed and within the planned parameters for the project. The GNSS GPS will confirm the known monument location. If the coordinates are within the GPS tolerance of less than 2m (GNSS GPS) the control monument will be considered as satisfactory.

After entering the water, the diver can view the underwater transects on the Shark Marine Navigation Tablet and navigate towards the outer edge of the pre-planned investigation area, as needed to begin investigation activities. Planned routes will be displayed on the Shark Marine Navigation Tablet, in one color for the diver to follow while actual diver's routes are plotted in another color. Route plotting and contact information will be recorded and reviewed daily and provided to USACE. Positioning information (i.e., tracks) obtained through GNSS navigation will be recorded by the Shark Marine Tablet and will allow the diver to visually follow his transect. The geo-referenced digital path will undergo QC review for coverage.

Divers will use hand-held underwater detectors during the survey to locate metallic items. Anomalies below the river bottom surface will be investigated using hand-digging methods. The diver will use their arm to reach into the silt and sand to identify the source of the anomaly. Anomalies found to be non-munitions related debris, such as metal strapping, cans, bolts, and other debris, will be left on-site, and the diver will continue along the transect. If an area is located containing dense anomalies, the diver will circumnavigate the area, collect GPS points and delineate the edges, and characterize select anomalies within the area without inspecting every anomaly.

Only suspect MEC/MPPEH or significant MD will be recorded by the diver. The diver will notify the topside support on the location and the potential find of the item. Significant MD will be collected by the diver. Divers will photograph any items identified as suspect MEC for evaluation. If water clarity is poor, divers will verify MEC through hand and feel measurement methods. Upon the completion of the investigation of the item, the divers will determine the length, diameter and if the item is fuzed. The diver will relay this information to the dive station for recording. Any suspected MPPEH/MEC item will be marked via GPS and if conditions allow with a weighted float (buoy) until a decision on whether the item is safe-to-move and subsequent action is made. Floats will be numbered and suspended several feet above the suspected MEC items but will not be visible from the water surface.

Once the MEC/MPPEH is GPS marked, divers will communicate via the video link with the surface and inform the DPIC/Dive Supervisor of their findings. The DPIC/Dive Supervisor will inform the EA SUXOS that suspected MEC/MPPEH has been found. The dive team will coordinate with EA and USACE to determine if item is acceptable-to-move and the appropriate exclusion zone distances.

If acceptable-to-move, a time for the item to be raised and transported to shore for final identification and disposal determination will be determined. MEC/MPPEH that is unacceptable-to-move will be marked by placing an offset buoy, left in place, and after first consulting with USACE the item will be blown-in place IAW the approved ESP (Appendix E), DDESB Technical Paper 16 (DDESB 2012) and the fragmentation database. Acceptable-to-move MEC/MPPEH items will either be carried directly to the shore, hoisted by a lifting harness into the boat and secured with sandbags, or raised with lift bags/balloons. When using lift bags/balloons, the diver will gradually inflate the lift balloon with an air hose and guide the item to the surface. If close enough to the shore, the item may be pulled directly to the shore with a pull line and the diver guiding the item otherwise the dive boat will pull the item to the recovery area. Further details on dive operations can be found in the Dive Operations Work Plan (Attachment H of the APP, Appendix B).

Once an item is at the shoreline and if too heavy to manually move, the item will be pulled remotely (at a distance beyond the hazardous fragmentation distance of the item or other approved distance) onto a designated area at or above the mean high tide and inspected to determine if MPPEH or MDAS. MDAS items and smaller MPPEH deemed acceptable-to-move will be manually lifted and placed into a vehicle for transport to the explosive storage magazine for temporary storage, in accordance with the ESP and the EMP. Items stored in the explosive storage magazine will be disposed of at a later date. MPPEH that is deemed too large or unsafe to transport and store in the explosive storage magazine will be disposed of at the shoreline.

Once an item is lifted above the surface the team will default to exclusion zone distances presented in the ESP or other hazard exclusion zones as determined by EA SUXOS. During operations, the DPIC/Dive Supervisor and boat coxswain will scan the area for boats, swimmers, or divers. If boats enter the area of dive operations, intrusive operations and lift operations will cease until the boat leaves the area.

DFW 10: Cued Data Threshold Verification and Cued Data Classification Validation

Cued data will be validated as described in Worksheet #35. All targets intrusively investigated will undergo a recovered item verification in which the recovered item will be compared to the predictions as described in ANJV SOP 9.

As part of the validation process, the project team will select 50 Priority 3 targets on the dig lists for excavation and the data analyst will provide a short description as to why each was classified as a non-TOI (e.g., too small, too thin-walled, asymmetric, poor match to library item) as described in ANJV SOP 10. Additionally, USACE may also select classification validation targets, if desired.

DFW 11: Post-Investigation VSP Analysis

The DGM and intrusive investigation results will be input to the VSP post investigation module to determine various density calculations for the site including total DGM anomaly density, DGM TOI density, AGC TOI density, MD density, NMRD density, and MEC density. This information will be used to determine the density and lateral extent of MEC within each of the areas investigated (i.e., MRS-01, former loading docks, dump area). If the MEC/MD density is greater than 20 anomalies/acre above background within any areas of MRS-1, then the area(s) will be treated as a CMUA rather than a NCMUA and four to six grids will be mapped and intrusively investigated within the area(s) of elevated munitions density.

DFW 12: Final Data Usability Assessment

Upon completion of the intrusive investigation, a final DUA will be completed using the four-step process described in Worksheet #37 which requires review and acceptance by USACE. Usability will be based on achievement of DQOs and MPCs. The Final DUA report will be submitted with the Final RI Report.

DFW 13: Site Restoration and Demobilization

EA will restore the site to its original condition (e.g., backfill any excavations or holes and seed, as necessary). EA and all subcontractors will then demobilize all equipment and personnel from the site.

DATA USE AND RISK ASSESSMENTS

***MEC, FUDS Risk Management Methodology*—**To evaluate if there are acceptable or unacceptable human health risks due to potential MEC presence at the Test Area 7 MRS Study Area, a risk assessment will be performed in accordance with *Trial Period for Risk Management Methodology at FUDS MMRP Projects* (USACE, 2017).

The MEC Risk Management Methodology will be applied to differentiate acceptable versus unacceptable site conditions. Using the site-specific CSM data, the risk assessment evaluated the likelihood of encounter, severity of encounter, and likelihood of detonation. This information will be used to support the acceptable/unacceptable risk determination at the site. The risk assessment consists of four matrices:

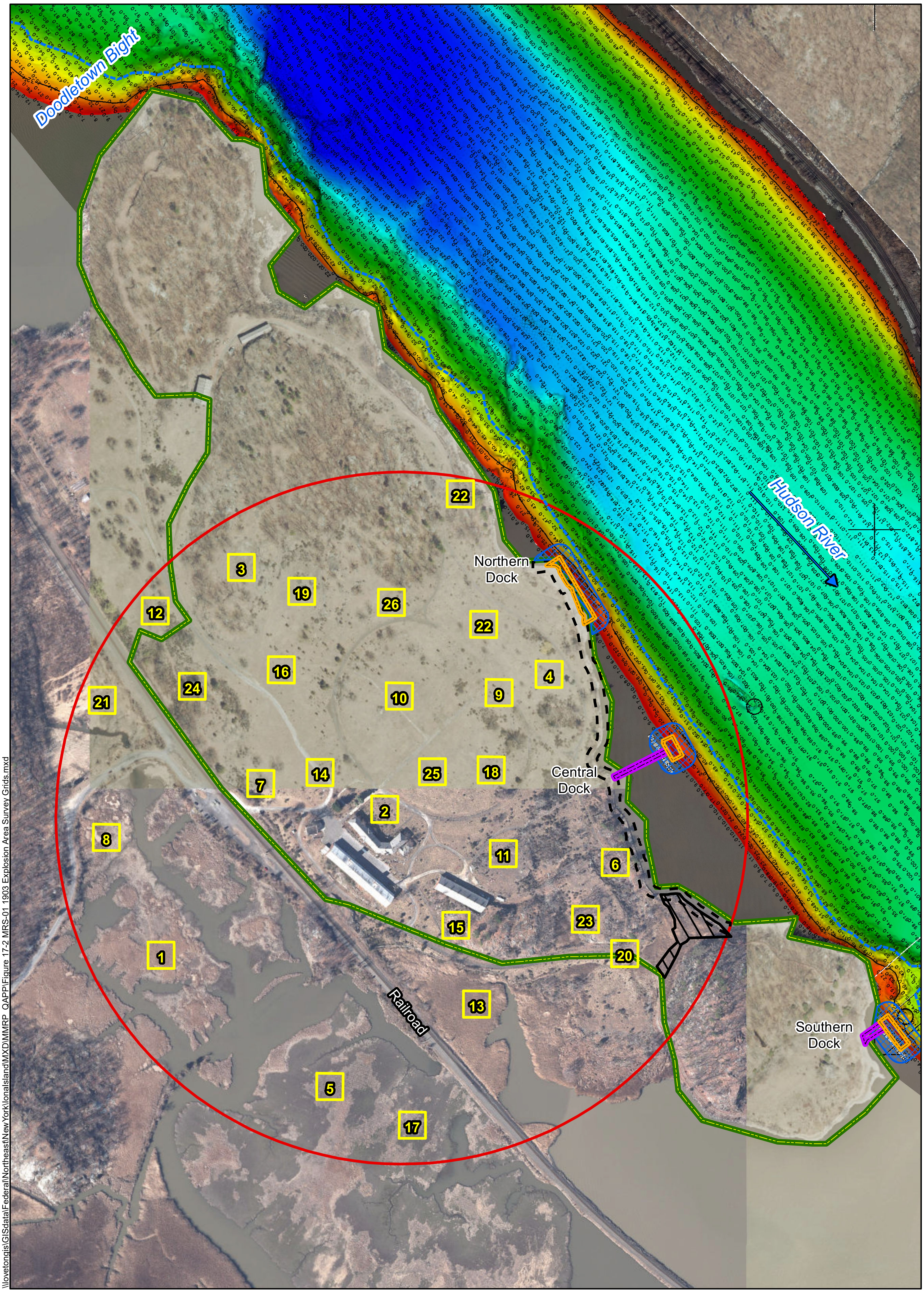
- Matrix 1: Evaluates the likelihood of an MEC encounter based on access conditions and the amount of MEC.

- Matrix 2: Evaluates the severity of an incident based on the likelihood of encounter (determined in Matrix 1) and severity associated with unintentional detonation of the MEC items at the Site.

- Matrix 3: Evaluates the likelihood of detonation based on MEC sensitivity and the likelihood to impart energy on an item.

- Matrix 4: Identifies acceptable or unacceptable site conditions, based on the results from Matrix 2 and 3.

The MEC Risk Management Methodology considers site-specific current or reasonably anticipated future land use scenarios.



\\lovetongis\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 17-2 MRS-01 1903 Explosion Area Survey Grids.mxd

0 450 900
Feet

N

Legend

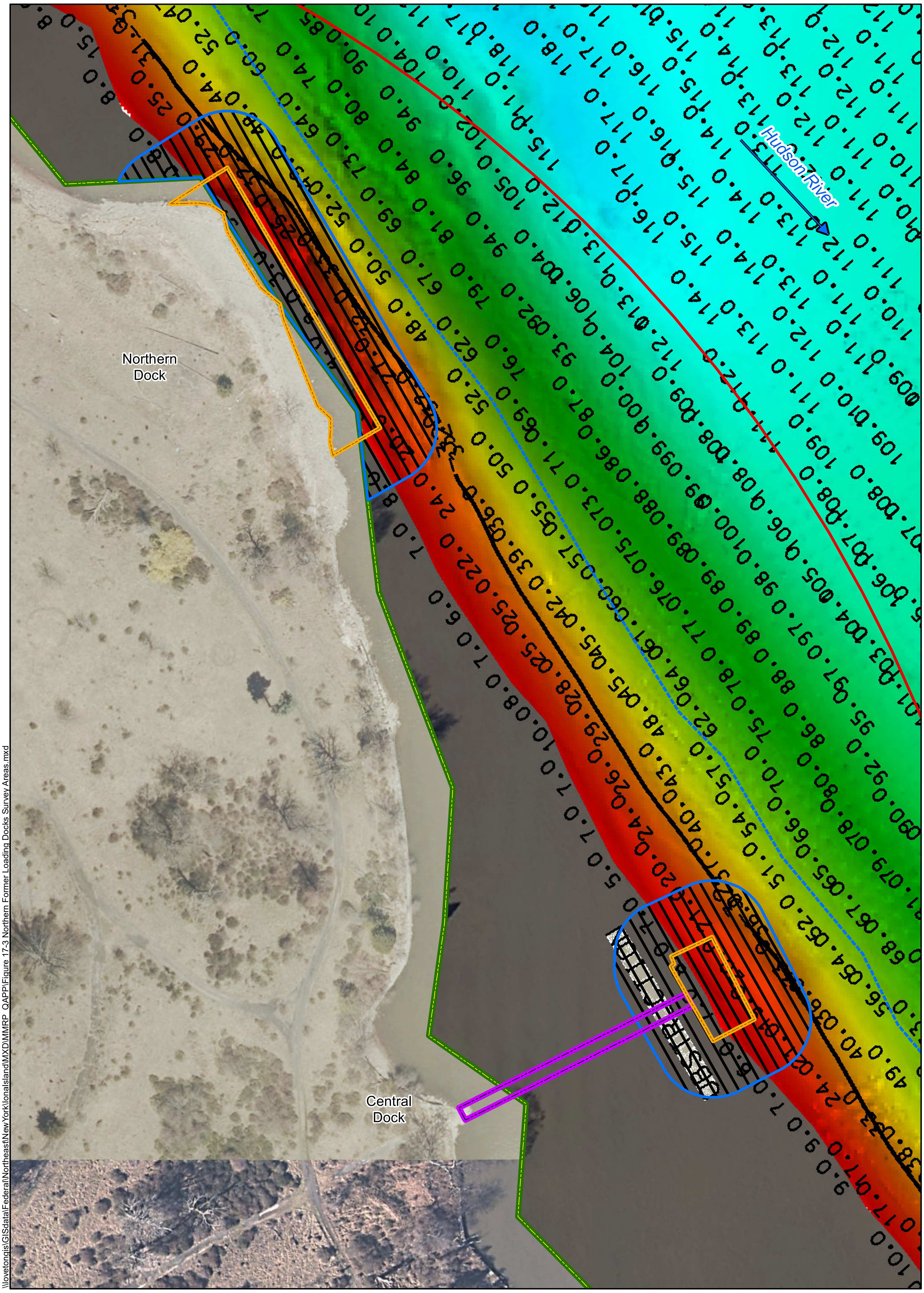
- Approximate 60 Foot Depth Line
- DGM Grid (100ft x 100ft)
- Underwater Investigation Area (Former Docks)
- DGM Shoreline Area
- Dump SIte
- Former Dock
- Former Causeway
- FUDS Boundary
- MRS-01 1903 Explosion Area

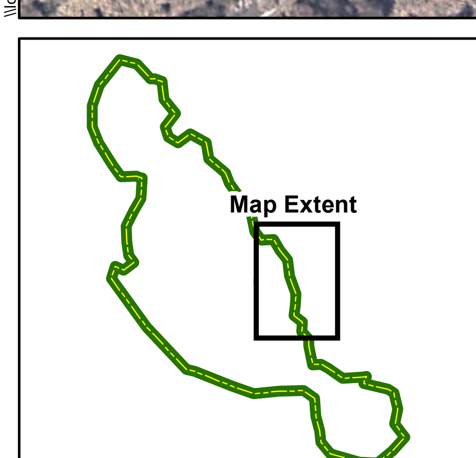
Note:
Dives will be limited to 3-60 ft or where the river bottom is less then 20 degree slope or determined acceptable by Direct Person in Charge.
Transects in water depth less then 3 ft will be walked.

FIGURE 17-2
MRS-01 1903 EXPLOSION AREA SURVEY GRIDS

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 10/03/2018
Dock Aerial - June 18 1948





0 100 200
Feet

N

Legend

- Approximate 60 Foot Depth Line
- Underwater Investigation Transect (10 ft)
- Underwater Investigation Area (Former Docks)
- Former Dock
- Former Causeway
- FUDS Boundary
- MRS-01 1903 Explosion Area

FIGURE 17-3
NORTHERN FORMER LOADING DOCKS SURVEY AREAS

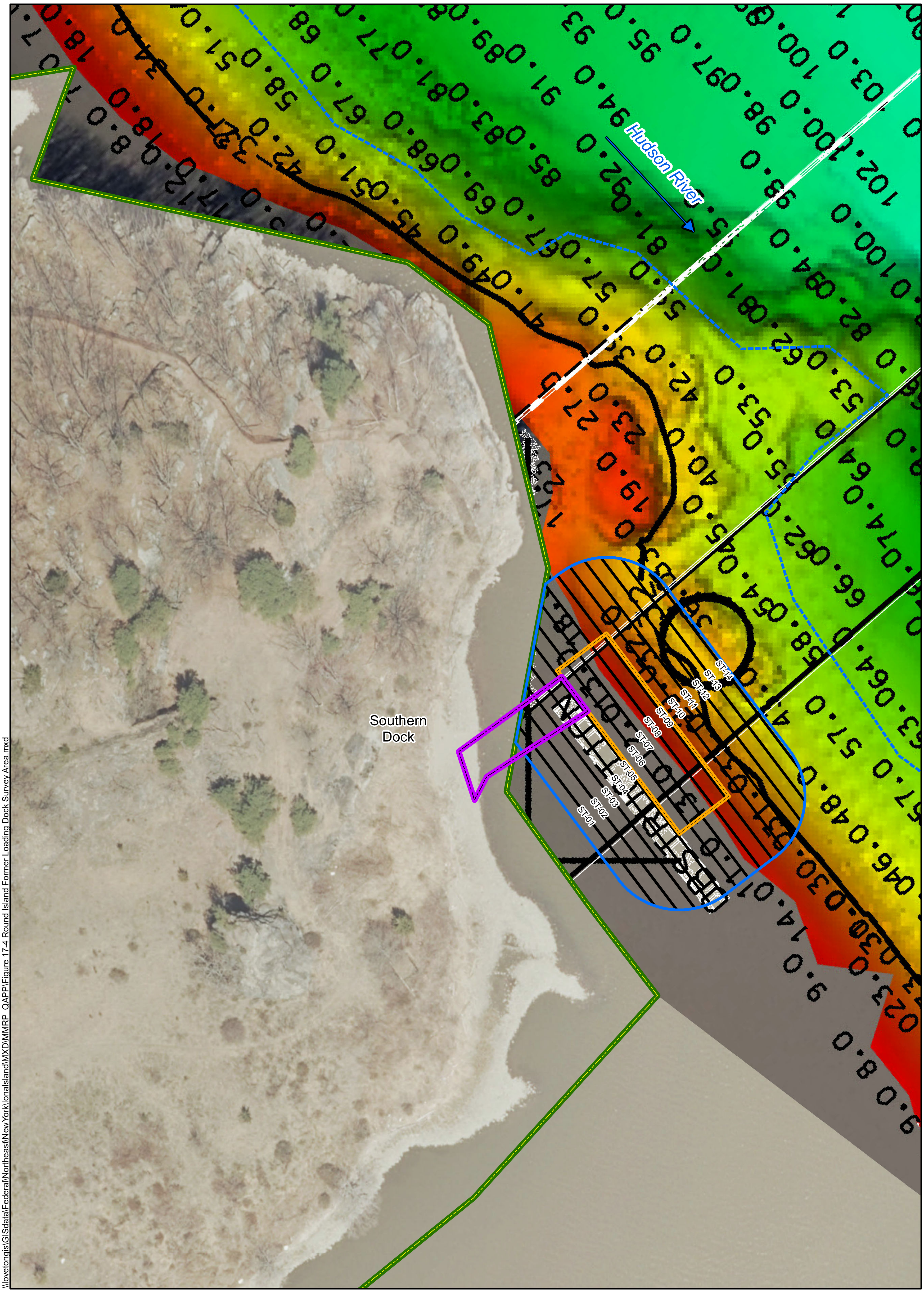
IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

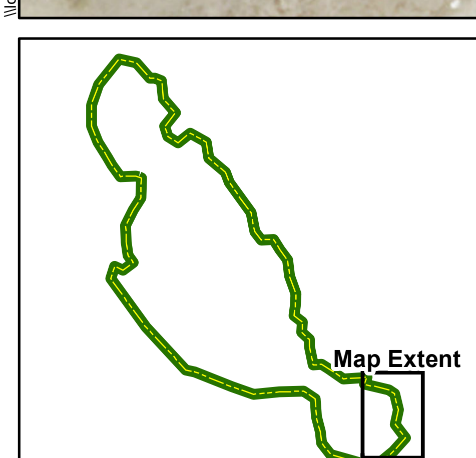
Map Date: 10/03/2018
Dock Aerial - June 18 1948

Note:
Dives will be limited to 3-60 ft or where the river bottom is less then 20 degree slope or determined acceptable by Direct Person in Charge.
Transects in water depth less then 3 ft will be walked.

\\lovetongis\GIS\data\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 17-3 Northern Former Loading Docks Survey Areas.mxd

\\lovetongis\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP QAPP\Figure 17-4 Round Island Former Loading Dock Survey Area.mxd





0 75 150
Feet

N

Legend

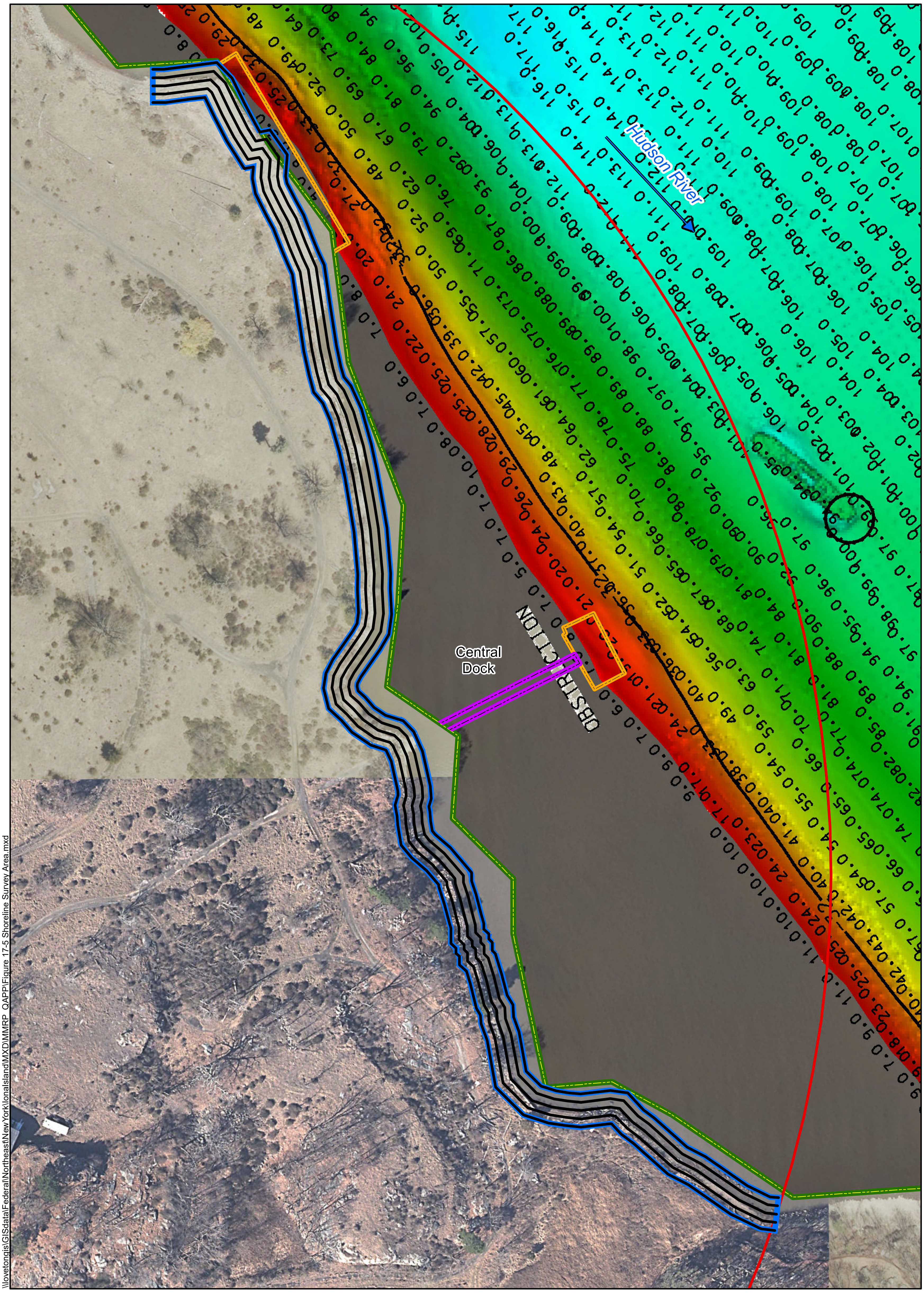
- Approximate 60 Foot Depth Line
- Underwater Investigation Transect (10 ft)
- Underwater Investigation Area (Former Docks)
- Former Causeway
- Former Dock
- FUDS Boundary

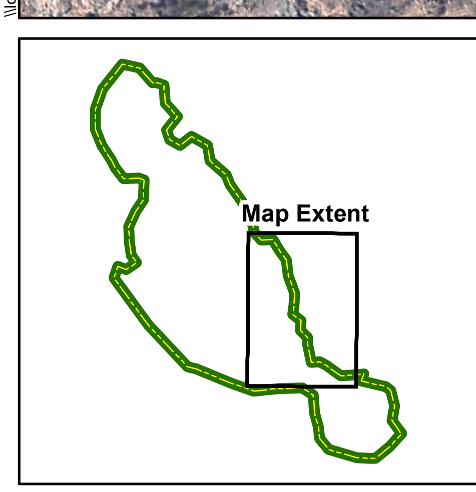
FIGURE 17-4
ROUND ISLAND FORMER LOADING DOCK SURVEY AREA

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 10/03/2018
Dock Aerial - June 18 1948

Note:
Dives will be limited to 3-60 ft or where the river bottom is less then 20 degree slope or determined acceptable by Direct Person in Charge.
Transects in water depth less then 3 ft will be walked.





\\lovetongis\GIS\data\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 17-5 Shoreline Survey Area.mxd

0 150 300
Feet

N

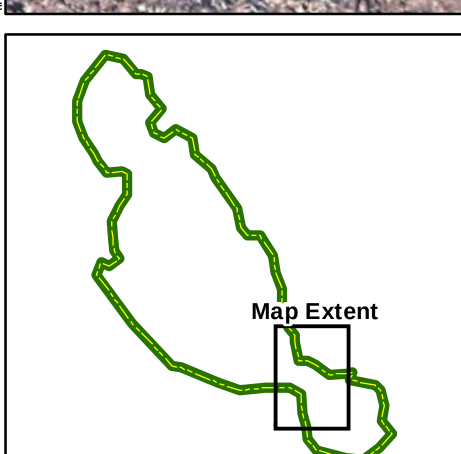
Legend

- DGM Transect (10ft spacing)
- DGM Shoreline Survey Area
- FUDS Boundary
- Former Causeway
- Former Dock
- MRS-01 1903 Explosion Area

FIGURE 17-5
SHORELINE SURVEY AREA

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 10/03/2018



0 100 200

Feet

N

Legend

- DGM Transect (10ft spacing)
- DGM Survey Area
- FUDS Boundary
- MRS-01 1903 Explosion Area

FIGURE 17-6

DUMP SITE SURVEY AREA

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE ROCKLAND COUNTY, NY

Map Date: 10/03/2018

\\lovetonGIS\GIS\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\WorkPlan\Figure 17-6 Dump Area Survey Area.mxd

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QAPP Worksheet #18: Sampling Locations and Methods

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #20: Field Quality Control

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #21: Field Standard Operating Procedures (MC Sampling SOPs)

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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

(MEC Investigation SOPs)

This worksheet documents procedures for performing testing, inspections and quality control for all field data collection activities. References to the applicable DFW and SOPs are included. Failure response must include an RCA to determine the appropriate CA.

Table 22-1 Site Preparation

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Grid/transect stakeout-accuracy	DFW 2/ MR SOP 004	Start of day when RTK GPS is used	Team Lead/Field Form-Log book/DGM QC Geophysicist	Positional error of the RTK GPS at a known/temporary monument will not exceed ± 0.328 ft (10 centimeters [cm]).	RCA/CA.
Vegetation removal-completeness	DFW 2/ MR SOP 003	Per grid	UXO Team Lead/Field Forms-Log book/DGM Site Geophysicist	Grass/vegetation must be <12 in. in height or low enough for DGM/AGC instruments to function at correct instrument height.	RCA/CA.
Surface sweep-completeness	DFW 2/ MR SOP 004	Per grid	UXO Team Lead/Field Forms/UXOQCS	There must be no finding of MEC regardless of size and no metal 0.75-in. radius by 2.5-in. length or larger in size found on the surface. Any MEC or MD discovered is documented in the project database and in field forms.	RCA/CA.
Blind seeding-accuracy	DFW 3/ MR SOP 010	Start of day when RTK GPS is used	UXOQCS/Blind Seed Log/DGM QC Geophysicist	Positional error of the RTK GPS at a known/temporary monument will not exceed ± 0.328 ft (10 cm). Locations, depth, and orientation of blind seeds recorded in field logs and in project database.	RCA/CA.

1) Field SOPs are provided in Appendix F.

Table 22-2 Detection Survey (Instrument EM61)

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Verify correct assembly	DFW 4/ ANJV DGM 01	Once following assembly	Field Team Leader/ instrument assembly checklist/Project Geophysicist	As specified in Assembly checklist.	RCA/CA: Make necessary adjustments and re-verify.
Initial Instrument Function Test (EM61)	DFW 4/ ANJV DGM 01	Once following assembly	Field Geophysicist/ Initial IVS Memorandum/ Project Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all channels.	RCA/CA: Make necessary adjustments and re-verify.
Initial detection survey positioning accuracy (IVS)	DFW 5/ ANJV DGM 01	Once prior to start of detection survey 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.
Ongoing Instrument Function Test (EM61)	DFW 5/ ANJV DGM 01	Beginning and end of each day and each time instrument is turned on	Field Team Leader/ running QC summary/Project or QC Geophysicist	Response (mean static spike minus mean static background) within 20% of predicted response for all channels.	RCA/CA: Make necessary repairs and re-verify.
Ongoing detection survey positioning precision (IVS)	DFW 5/ ANJV DGM 01	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 5/ ANJV DGM 01	Verified for each survey unit based upon monostatic Z coil data positions	Project Geophysicist/running QC summary/ QC Geophysicist	100% ≤ 0.25m between successive measurements.	RCA/CA.
Coverage (EM61 using electronic positioning)	DFW 5/ ANJV DGM 01	Verified for each survey unit using [describe tool to be used] based upon monostatic Z coil data	Project Geophysicist/running QC summary and survey unit validation report/QC Geophysicist	100% at project design cross-track measurement spacing (excluding site-specific access limitations, e.g., obstacles, unsafe terrain).	RCA/CA.
Detection survey repeatability (EM61)	DFW 5/ ANJV DGM 01	Evaluated by survey unit	Project Geophysicist/running QC summary and survey unit validation report/QC Geophysicist	QC seed response must be >75% of minimum predicted response at geometric center of anomaly.	RCA/CA.
Detection survey performance	DFW 5/ ANJV DGM 02	Evaluated by survey unit	QC Geophysicist/survey unit validation report/ lead organization QA Geophysicist	All blind QC seeds must be detected and positioned within 60 cm radius of ground truth.	RCA/CA.
Valid position data	DFW 5/ ANJV DGM 02	Per measurement	Field Team Leader/running QC summary/Project Geophysicist	GPS status flag indicates real-time kinematic (RTK) fix and dilution of precision (DOP) less than 4.0.	RCA/CA: Out-of-spec data rejected.
Valid orientation data	DFW 5/ ANJV DGM 02	Per measurement	Field Team Leader/running QC summary/Project Geophysicist	Orientation data reviewed and appear reasonable within bounds appropriate to site.	RCA/CA: Unreasonable data rejected.

1) Field SOPs are provided in Appendix F.

Table 22-3 Cued Survey (Instrument: MetalMapper 2x2; Classification Tool: UX-Analyze)

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Verify correct assembly	DFW 6/ ANJV SOP 1MM2	Once following assembly	Field Team Leader/ instrument assembly checklist/Project Geophysicist	As specified in instrument assembly checklist.	RCA/CA: Make necessary adjustments, and re-verify.
Initial instrument function test (MM2x2)	DFW 6/ ANJV SOP 1MM2	Once following assembly	Field Team Leader/ instrument assembly checklist/ Project Geophysicist	Response (mean static spike minus mean static background) with 20% of predicted response for all monostatic Tx/Rx combinations.	RCA/CA: make necessary repairs/ adjustments and re- verify.
Initial IVS background measurement and background verification	DFW 6/ ANJV SOP 2/8	Once during initial system IVS test	Field Team Leader/ Initial IVS memorandum/ Project Geophysicist	All five measurements (decay amplitude) within the noise level of each other and library match from all four offset measurements >0.9.	RCA/CA: reject/replace BG Location.
Initial derived polarizabilities accuracy (IVS)	DFW 6/ ANJV SOP 2	Once during initial system IVS test	Project Geophysicist/ Initial IVS memorandum/ QC Geophysicist	Library Match metric ≥ 0.9 for each set of inverted polarizabilities.	RCA/CA.
Derived target position accuracy (IVS)	DFW 6/ ANJV SOP 2/8	Once during initial system IVS test	Project Geophysicist/ Initial IVS Memorandum/QC Geophysicist	All IVS item fit locations within 0.25m of ground truth locations.	RCA/CA.
Ongoing derived polarizabilities precision (IVS)	DFW 7/ ANJV SOP 8	Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/QC Geophysicist	Library Match to initial polarizabilities metric ≥ 0.9 for each set of three inverted polarizabilities.	RCA/CA.
Ongoing derived target position precision (IVS)	DFW 7/ ANJV SOP 8	Beginning and end of each day as part of IVS testing	Project Geophysicist/ tracking summary/QC Geophysicist	All IVS items fit locations within 0.25m of average of derived fit locations.	RCA/CA.
Initial measurement of production area background locations and background verification	DFW 7/ ANJV SOP 6/8	Once per background location	Field Team Leader/ background location report/Project Geophysicist	All five measurements (decay amplitude) within the noise level of each other and library match from all four offset measurements >0.9.	RCA/CA: reject BG location and find alternate.
Ongoing production area background measurements	DFW 7/ ANJV SOP 6/8	Background data collected a minimum of every two hours during production	Field Team Leader/failures noted in field log and tracking summary/Project Geophysicist	Original and ongoing measurements at each location differs by a factor of five or less.	RCA/CA: document environmental changes. Project Geophysicist must approve before proceeding.
Ongoing instrument function test (MM2x2)	DFW 7 ANJV SOP 1MM2	Each time instrument is turned on	Field Team Leader/ tracking summary/ Project Geophysicist	Response within 20% of predicted response.	RCA/CA: Make necessary repairs and re-verify.
Transmit current levels (MM2x2)	DFW 7/ ANJV SOP 7/8	Evaluated for each sensor measurement	Field Team Leader/ tracking summary/ Project Geophysicist	Current must be ≥0.8 amperes.	RCA/CA: stop data acquisition activities until condition corrected.
Confirm all background measurements are valid	DFW 7/ ANJV SOP 8	Evaluated for each background measurement	Project Geophysicist/ Background summary/ QC Geophysicist	Ensure background variation does not impact ability to classify correctly.	RCA/CA: BG measurement rejected and removed from active BG measurements.
Confirm adequate spacing between units (MM2x2)	DFW 7/ ANJV SOP 6/7	Evaluated at start of each day (or grid)	Field Team Leader/Field Logbook/Project Geophysicist	Minimum separation of 25m.	RCA/CA: Recollect all coincident measurements.
Confirm inversion model supports classification (1 of 3)	DFW 7/ ANJV SOP 8	Evaluated for all models derived from a measurement (i.e., single item and multi- item models)	Project Geophysicist/Measurement QC summary/ QC Geophysicist	Derived model response must fit the observed data with a fit coherence ≥ 0.8.	Follow procedure in SOP or RCA/CA.
Confirm inversion model supports classification (2 of 3)	DFW 7/ ANJV SOP 8	Evaluated for derived target	Project Geophysicist/Measurement QC summary/ QC Geophysicist	Fit location estimates of item ≤ 0.4m from center of sensor.	Follow procedure in SOP or RCA/CA.

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/ Report Method/ Verified by:	Acceptance Criteria	Failure Response
Confirm inversion model supports classification (3 of 3)	DFW 7/ ANJV SOP 8	Evaluated for all seeds	QC Geophysicist/ Measurement Inversion model QC summary/lead organization QA Geophysicist	100% of predicted seed positions ≤ 0.25m radially from known position (x, y). Z ≤ .15m).	RCA/CA.
Confirm reacquisition GPS precision	DFW 7/ ANJV SOP 11	Daily	UXO tech or field tech/ Daily QC Report/ Project Geophysicist	Benchmark positions repeatable to within 10cm.	RCA/CA.
Classification performance	DFW 7/ ANJV SOP 10	Evaluated for all seeds	QC Geophysicist, USACE QA Geophysicist/ Ranked Dig List/USACE QA Geophysicist	100% of QC and validation seeds placed on dig list.	RCA/CA.

1) Field SOPs are provided in Appendix F.

Table 22-4 Intrusive Investigation

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Dive survey, initial/ongoing hand-held detector performance, repeatability	DFW 9/ Appendix B-Dive Plan	Start and end of workday	Instrument operator/Logbook/UXOQCS	Positive response of hand-held sensor to the presence of metal in the IVS.	Recheck instrument, follow procedures in SOP, replace instrument as needed.
Dive survey, ongoing detector performance, sensitivity	DFW 9/ Appendix B-Dive Plan	Before and after each dive	Instrument operator/Logbook/Dive Supervisor	Test detector against small item (i.e., knife, metal pole etc.) at the start of the dive and upon returning to dive boat to ensure audible signal is produced.	Recheck instrument, follow procedures in SOP replace equipment if needed, retrain operator and reverify, rework of transects impacted.
Dive survey, completeness	DFW 9/ Appendix B-Dive Plan	Before and after each dive	Instrument operator/Logbook/Dive Supervisor	100% of transect is completed or documented on obstructions or other interference preventing completing transect.	Retrain operator and reverify, rework of transects impacted.
Hand-held sensor detection performance-Land based survey	DFW 8 MR SOP 004/005	Start of day when hand-held sensor is used	Field Tech/Logbook/Team Lead	Positive response of hand-held sensor to the presence of metal in the IVS.	Recheck instrument-follow procedures in SOP, replace instrument as needed.
Target Reacquisition-accuracy	DFW 8/ MR SOP 16	Start of day when RTK GPS is used	Field Tech/Logbook/Team Lead	Positional error of the RTK GPS at a known/temporary monument will not exceed ± 0.328 ft (10 cm).	Recheck instrument-RCA/CA.
MEC/MPPEH Disposition – MDAS Disposition	DFW 8/ MR SOP 006/009	Initially in grid, and again during re-inspection by SUXOS and verification by UXOQCS	Team Lead (in grid) and SUXOS/Field Forms/UXOQCS	Can see through all the components to ensure no potential energetic material remains. No energetic item(s) are classified as MDAS.	Identify cause of misidentification (if applicable) and redo affected work.
MEC/MPPEH Disposition – MDAS Disposition	DFW 8/ MR SOP 006/009	Daily when MD is recovered	SUXOS/Field Forms/UXOQCS	All MDAS is re-inspected, secured, certified and verified before final disposition. Documents are prepared and signed.	Re-inspect all material in lockable container.
MEC Data Collection	DFW 7	Daily when MEC is recovered	Field Tech/Logbook/Team Lead	Completeness of the collection of attributes (Worksheet #17) for each MEC item recovered.	RCA/CA. Collect missing data prior to disposal.
Intrusive data is captured in project database	DFW 8/MR SOP 14	Weekly	Data Manager/Field Forms/UXOQCS	Project database is complete and correct.	RCA/CA.
Confirm derived features match ground truth (1 of 2)	DFW 11/ ANJV SOP 10	Evaluated for all recovered items	Project Geophysicist/Measurement QC Summary or intrusive database/QC Geophysicist	100% of recovered (excluding inconclusive category) item positions ≤ 0.25m from predicted position (x, y).	RCA/CA.
Confirm derived features match ground truth (2 of 2)	DFW 11/ ANJV SOP 10	Evaluated for all recovered items	Project Geophysicist/ Dig List and intrusive database/QC Geophysicist	100% of recovered object size estimates (excluding inconclusive category) qualitatively match predicted size.	RCA/CA.
Verification of TOI/non-TOI threshold	DFW 11/ ANJV SOP 10	Dig 50 anomalies beyond last TOI on Dig List	Project Geophysicist/ Verification and Validation Report/QC Geophysicist	100% of predicted non-TOI intrusively investigated are non-TOI.	RCA/CA. Adjust threshold.
Classification validation	DFW 11/ ANJV SOP 10	Dig random selection of non-TOI	QA Geophysicist/Verification and Validation Report/QC Geophysicist	100% of predicted non-TOI qualitatively matches predicted size/shape.	RCA/CA. Document in DUA.

1) Field SOPs are provided in Appendix F.

Table 22-5 Detection Survey (Analog Instrument)

Measurement Quality Objective	DFW/SOP Reference[1]	Frequency	Responsible Person/Report Method/ Verified by:	Acceptance Criteria	Failure Response
Initial/ongoing hand-held detector performance, repeatability	DFW 8 MR SOP 004/005	Start of day when hand-held sensor is used	Instrument operator /Logbook/Team Lead	Positive response of hand-held sensor to the presence of all seed items in the IVS.	Recheck instrument-follow procedures in SOP, replace instrument as needed.
Ongoing detector performance, sensitivity	DFW 8 MR SOP 004/005	Start of day and end of day and when hand-held sensor is turned on	Instrument operator /Logbook/Team Lead	Positive response of hand-held sensor to the presence of standard object.	Recheck instrument-follow procedures in SOP, replace instrument as needed.
Maximum velocity	DFW 8 MR SOP 004/005	Hourly	Instrument operator/Logbook/Team Lead	98% ≤0.45 meters/sec and 100% ≤ 0.5 meter per second.	RCA, redo affected work.
Dynamic repeatability	DFW 8 MR SOP 004/005	Daily check of each operator, along 50 m section of grid or transect	Field Tech/Logbook/UXOQCS	Repeat a segment of grid or transect and show the number of subsurface anomalies repeated within the greater of ±20% or ±8, or within range of adjacent segments.	RCA, redo affected work.
Grid coverage	DFW 8 MR SOP 004/005	Each grid	Field Tech/Logbook/Team Lead	Visual inspection and/or photographic records of survey lanes/lines established.	RCA/CA.
Detection and recovery	DFW 8 MR SOP 004/005	Five to six blinds seeds per operator per day	Instrument operator//Field Forms/UXOQCS	100% of blind seeds are recovered.	RCA, redo affected work.
Anomaly resolution	DFW 8 MR SOP 004/005	Check 20% of all anomalies in each grid	Instrument operator//Field Forms/UXOQCS	100% of checked holes are resolved (no hand-held instrument response).	RCA, redo affected work.

1) Field SOPs are provided in Appendix F.

QAPP Worksheet #23: Analytical Standard Operating Procedures

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #24: Analytical Instrument Calibration

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #28: Analytical Quality Control and Corrective Action

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #29: Project Documents and Records

This worksheet provides (1) minimum specifications for all data management tasks and deliverables, and (2) procedures for controlling project documents, records, and databases. Its purpose is to ensure data completeness, data integrity, traceability and ease of retrieval.

DATA MANAGEMENT SPECIFICATIONS

Geographic Information System

A project-specific GIS will be used to store and manage all relevant geospatial-related data and information. All data must have a datum of WGS84 and a projection of Universal Transverse Mercator Zone 18N. Any data with a vertical component must be referenced to the North American Vertical Datum of 1988. The spatial reference must have a precision of 1,000. Each GIS data set will be accompanied by metadata conforming to the Federal Geospatial Data Committee Content Standard for Digital Geospatial Metadata and provided in a database that complies with the Spatial Data Standards for Facilities, Infrastructure, and Environment. The final GIS submittal will contain all required ArcGIS.mxd files and layout files for all drawings contained in the final report.

In addition, the location, identification, coordinates, and elevations of all established control points will be plotted on one or more site maps. Each control point will be identified on the map by its name and number and the final adjusted coordinates.

Environmental System Research Institute, Inc.-compliant formats (shapefiles, coverages, or geodatabases) will be used to present GIS data, with supporting tabular data provided in Microsoft Excel, Microsoft Access, or both, as needed.

Computer Files and Digital Data

Final document files, including reports, figures, and tables, will be submitted in electronic format (both Microsoft Office 2013 [or later], and portable document format [PDF]) via email transmission, secure file transfer protocol or secure SharePoint sites. If necessary due to access limitations or file sizes, information will be provided on digital versatile disc. The EA secure network server will be utilized for long-term data storage and secure back-up of information.

Native geophysical data files will be provided IAW the deliverables requirements in this QAPP and associated SOPs for the various DFWs. Images will be presented in standard graphics formats (.PNG, .JPG) for insertion into documents. The native files may include the following:

- Raw geophysical sensor files
- Raw sensor files formatted for input into Geosoft Oasis Montaj (Geosoft)
- Geosoft database (.GDB) files containing raw data channels and processed data channels

- Geosoft grid (.GRD) and packed map (.MAP) files for data sets where gridding and contouring will be performed as part of generation of a false-color results map

- Exported database files (. XYZ or .CSV) in format readable by Geosoft, including target lists

- Images of QC test results

- Raw digital photographs

DoD TOI Library: The most up-to-date version of the DoD TOI Library at the time of beginning the classification process will be used for this project. The library may be augmented with data collected during previous projects. A site-specific library of polarizabilities for munitions items identified in the CSM will be used as the primary means of classification. Entries in the augmented DoD TOI Library will be confirmed as representative (i.e., the same caliber, model, and configuration) of munitions items presented in the CSM by a qualified UXO technician and will be compiled in the site-specific library. Intrinsic parameters for items listed in the CSM not confirmed to be in existing libraries will be derived from test measurements prior to the start of the classification process (if the items are available). In addition to comparison versus the site-specific CSM library, cued data will also be compared to the full augmented DoD TOI Library containing polarizabilities for items not expected at the site. Close matches to items in the augmented DoD TOI Library, as well as potential TOI clusters identified via feature space analysis, will be requested as Analyst Calibration Digs. Analyst Calibration Digs that are identified as TOIs upon excavation will be added to the site-specific library. The DoD TOI Library will be included in data deliverables.

All final document files, including reports, figures, and tables, will be submitted in electronic format (both Microsoft Office 2013 or later and PDF) on CD-ROM.

SUBMITTAL MANAGEMENT

Submittals include deliverables generated by EA and may involve submittals generated by subcontractors. The Project Manager is responsible for the overall management and control of project submittals, as well as scheduling and tracking each submittal. The Project Manager will establish and maintain a project submittal schedule that reflects the draft, draft final, and final deliverable status. The Project Manager is also responsible for establishing and maintaining a project file so that project documents may be retained and controlled appropriately. Document submittal activities have been incorporated into the project schedule. The Project Manager will monitor the progress of project submittals and update the submittal schedule on a regular basis.

The Project Manager, Senior Technical Reviewer, and QC Geophysicist are responsible for ensuring, through detailed review, that field QC submittals, as well as the materials and work they represent, are compliant with applicable contractual specifications and project plans.

Review of Plans and Specifications

During the preparatory phase for each DFW, as discussed in Worksheet #31, the UXOQCS will ensure that the DFWs are IAW QAPP requirements and request clarification whenever necessary. The primary purpose of this review is to identify and resolve potential conflicts before initiating work operations. To minimize schedule impacts, QC checks will be performed as early in the process as practical to allow sufficient time for evaluation and response formulation. A QC Surveillance Report (Appendix G) will be completed for each DFW and each phase (i.e., preparatory, initial, or follow-up).

Review and Approval of Submittals

Prior to delivery, project submittals will be reviewed internally at EA. Submittal reviews will be delegated by the Project Manager and the review team will typically include Senior Technical Reviewer, QC Geophysicist, and Project Manager. Reviewer signatures are required on each submittal. Technical documents (plans and reports) will be first reviewed by the Project Manager and qualified technical staff. Before submittal, the document will be submitted to the Senior Technical Reviewer for final review and approval.

Quality Control Document Review and Submittal

The QC file will be maintained by the UXOQCS and is an integral component of the project file. Field Change Requests, Non-Conformance Reports, Corrective Action Reports (CARs), CA Plans, and other field-generated reports will be reviewed and accepted by the Project Manager and Corporate QA/QC Officer before submittal to USACE and NPS.

Field Logs and Records

Original field logs and records will be maintained by the Project Manager, SUXOS, UXOSO/QCS, and Project Geophysicist as part the project files. In addition to using hard copy documentation in the field, EA will utilize field tablets to collect data. This is particularly useful for the intrusive anomaly investigation teams as data and photographs can be collected on the same device. Additionally, by using tablets transcription errors are alleviated and data consistency increases. EA will develop data tables for the tablets that provide the UXO technicians with a consistent list of munitions items and site conditions to select from while still affording them the opportunity to address items that are not consistent with the CSM. Data quality and integrity increases dramatically by using this methodology. To ensure that data are secure and available for daily reporting and progress updates all field tablets will be downloaded to a field computer at the end of each workday.

The project file will be structured to include a copy of the following documents and information:

- Schedule and progress reports
- Project plans and procedures including addenda and modifications
- Delivery orders and other contract modifications

- UXO information forms/incident reports
- Location and survey records
- Meeting minutes and agenda
- Inspection logs
- Site maps
- Qualifications and training records of all site personnel
- Photo documentation
- Non-conformance reports and CARs.
- Field Change Request Form
- Dive logs and records
- Accident Reports

As the project activities progress, the Project Manager will monitor the usefulness of the project filing system for information retrieval. If additional files are needed, the filing structure may be expanded as necessary to include relevant information.

Daily Quality Control Reports

Daily work activity summary reports will be maintained by the UXOQCS. These daily reports may include, but are not limited to, the following items:

- QC reports and findings
- Health and safety reports
- SUXOS reports (including activity log, and grid tracking that will reflect surface clearance, mag and dig, intrusive anomaly investigation, QC, and QA)
- Reports on any emergency response actions
- MEC discovery and classification of the item
- Records of site work and progress.

The daily QC activities will be recorded on the Daily QC Report (Appendix D).

Field Logbooks

The SUXOS, UXOSO, UXOQCS, and each field team leader is responsible for maintaining paginated, bound, and dated hard copy Field Logbooks to record activities that occur each workday. Each logbook entry will be event-, area-, or site-specific and clearly noted accordingly. At the conclusion of the project, logbook entries will become a permanent part of the contract record.

Safety Logbook

The UXOSO will maintain a logbook that summarizes daily safety activities. This Safety Logbook will document compliance with the APP/SSHP. A Safety Logbook will be maintained as paginated, bound, and dated hard copy logs. The Safety Logbook will record such information as the date, start and stop times of work, weather conditions, names of field team personnel, specific description of the work being conducted, break times, names and times of visitors to the site, and any incidents or other unusual events that occur on that day. This includes documentation of the performance and content of daily health and safety meetings. The APP/SSHP (Appendix B) provides additional details on the Safety Logbook. The Safety Logbook will be turned over to the Project Manager and become a permanent part of the contract record.

Quality Control Logbook

The UXOQCS will maintain a QC logbook that summarizes field QC inspections. This logbook will document compliance with the QAPP and specify workmanship acceptability. The logbook will be portable and dedicated to the event or site. A QC logbook will be maintained as paginated, bound, and dated hard copy logs. The area and DFW being inspected, and the date will be recorded. Each logbook entry will be event-, area-, or site-specific and clearly noted accordingly. A QC logbook will be turned over to the Project Manager and become a permanent part of the contract record, in addition to the completed specific QC forms specified above.

Test, Maintenance, and Calibration Records

Any equipment test, maintenance, or calibration task will be documented in a field logbook by the individual performing the task. Testing and maintenance geophysical instruments and other field equipment will be performed per the manufacturer’s specifications and this QAPP. Geophysical detection equipment will be tested daily, as specified in Worksheet #22. At a minimum the test, calibration, or maintenance log will contain the date and time of the task, equipment name and identification numbers, name of individual performing the task, and results of the task.

The UXOQCS and QC Geophysicist are responsible for ensuring that the tests are performed and documented. QC documentation is discussed in Worksheet #31.

Training Records

The UXOSO will maintain a file for each site employee to document qualifications and the successful completion of the required training courses for that particular employee. The documentation may be a certificate, letter, memorandum, or other written form of documentation but must include the training completion date(s). If any required refresher training courses do not take place by the anniversary date of the employee’s initial training, there should be a record in the employee’s file indicating why the training has been delayed and when the training will be completed.

Photographic Log

Maintaining a Photographic Log will document the history and evolution of the project. The SUXOS, team leaders, and UXOSO/QCS will use their field logbooks and/or field tablets to document all photographs taken of site activities or MEC finds. At least two photographs of each definable feature of work will be taken, documented in the logbook entry/field tablet, and included in the RI Report with detailed captions. The logbook entry/field tablet will document the location, date, and subject of each photograph taken.

FUDSChem Data Management

Prior to field implementation of the MMRP field investigation, an eQAPP within FUDSChem will be created; the eQAPP will be fully compliant with the project UFP-QAPP. Geophysical data (native electronic format and pdf) will be managed in the FUDSChem per the requirements specified in the New England District Data Management Plan to ensure data deliverables are compliant with Performance Works Statement data requirements. Other types of data that will be uploaded to FUDSChem include spatial information pertaining to investigation locations (northing, easting, etc.).

Table 29-1 Control of Documents, Records, and Databases

Document/Record	Generation Purpose	Completion/ Update Frequency	Format/Storage Location/Archive Requirements
Equipment inspection/function tests: RTK GPS, DGM, and IVS certification forms	Verify daily inspection and function checks are conducted and documented.	Daily/minimum of weekly	Hard copy/Field office
DGM and AGC IVS Memorandums	Document initial IVS results.	After initial mobilization and testing of each system	Electronic copy/SharePoint or Server
SUXOS Logbook	Record all important events.	Daily	Hard copy/Field office
Daily Safety Meeting Attendance Log	Site-specific training and safety documentation.	Daily	Hard copy/Field office
Daily Status Reports	Report notable events to project team.	Daily	Electronic copy/SharePoint or Server
Accident Report	Record of any accidents on site for USACE, OSHA.	As required	Hard copy/Field office
Daily QC Report	Documents results of daily QC inspections and indicates whether RI activities have been conducted IAW all approved plans.	Daily	Electronic copy/SharePoint or Server
Weekly Geophysical QC Report	Report of QC results for each week of field activities.	Weekly	Electronic copy/SharePoint or Server/ Archived electronically
Team Leader’s Daily Log	Record of UXO Team’s activities (clearance, MEC/MD/other debris identified, targets excavated)	Daily	Hard copy/Field office
Field Change Request Form	Record of modifications to approach implemented in the field, and documentation of client approval	As required	Hard copy/Field office

Table 29-1 Control of Documents, Records, and Databases

Document/Record	Generation Purpose	Completion/ Update Frequency	Format/Storage Location/Archive Requirements
Root Cause Analysis	Document MPC failures and causes, as well as corrective actions taken, actions taken to prevent recurrence, and actions taken to monitor effectiveness of corrective action	As required	Electronic copy/SharePoint or Server
Photograph Log	Documents all photographs taken and video recorded to document work and/or site conditions, and to record MPPEH/MEC items recovered. Take at least two photographs of each DFW.	As required	Electronic copy/SharePoint or Server
Land Survey/Control Point Data Report	Documents land survey operations and the coordinates of established control points	Completed after surface land survey operations are complete.	Electronic copy/SharePoint or Server/
Control of Documents, Records, and Databases	Control of Documents, Records, and Databases	Control of Documents, Records, and Databases.	Control of Documents, Records, and Databases
SOP Checklists	Document completion of geophysical SOPs	As required	Electronic copy/SharePoint or Server/ Archived electronically
DGM Data Deliverables	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, Server, Archived Electronically
AGC Data Deliverables	Digital Record of all AGC data collected	AGC data deliverables for each week's data collection are due by the following Friday.	Digital data files/SharePoint, Server, Archived Electronically
AGC QC Deliverable	Record of all QC information related to AGC	AGC data deliverables for each week's data collection are due by the following Friday.	Electronic copy/SharePoint or Server/ Archived electronically

Table 29-1 Control of Documents, Records, and Databases

Document/Record	Generation Purpose	Completion/ Update Frequency	Format/Storage Location/Archive Requirements
Data Usability Assessments (cued survey and final DUA)	Provides assessment of data usability at various stages of project	Completed after each respective stage (dynamic detection survey, cued survey, and intrusive investigation).	Electronic copy/SharePoint or Server/ Archived electronically
Final Ranked Dig List	Documents the locations and classification decision (TOI, non-TOI or inconclusive) of cued survey targets in a prioritized list by likelihood of being TOI.	Completed after completion of cued data analysis.	Electronic copy/SharePoint or Server/ Archived electronically
Reacquisition Results	Documents location of reacquired AGC anomalies.	During reacquisition of AGC anomalies.	Electronic copy/SharePoint or Server/ Archived electronically
Intrusive Investigation Results	Documents the findings of the intrusive investigation to describe quantity, depth, size, orientation, description of each item, and other pertinent data related to the intrusive investigation.	Intrusive investigation results will be uploaded daily to a database.	Electronic copy/SharePoint or Server/ Archived electronically
Supporting Classification Images	Provide images that summarize modeling, library match information and classification decision for each cued target.	Completed after completion of cued data analysis.	Electronic copy/SharePoint or Server/ Archived electronically
Note: Hard copy records will be maintained in the field office for the duration of this project. Upon completion of the field activities, hard copy records will be maintained in the contractor's corporate office for the contract-required period.			

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QAPP Worksheets #31, #32, & #33: Assessments and Corrective Action

ASSESSMENTS AND CORRECTIVE ACTION FOR MUNITIONS AND EXPLOSIVES OF CONCERN ACTIVITIES

This worksheet documents the responsibilities and procedures for conducting project assessments, documenting assessments, responding to assessment findings and implementing corrective action. Appropriately scheduled assessments during each group of related project activities allow management to identify problems while the activities are being implemented, thereby allowing processes to be corrected before they have a negative impact on the achievement of DQOs and MPCs.

Three Phases of Control

The UXOQCS and/or QC Geophysicist is responsible for verifying compliance with this portion of the UFP-QAPP through implementation of a three-phase control process, that include preparatory, initial, and follow up inspections, which ensures that project activities comply with the approved plans and procedures. The specific QC monitoring requirements for each DFW are discussed below. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted and documented by the UXOQCS or QC Geophysicist.

The UXOQCS or QC Geophysicist will ensure that the three-phase control process is implemented for each DFW listed in Worksheets #12 and #17. Each phase is considered relevant for obtaining necessary product quality. However, the preparatory and initial inspections are particularly invaluable in preventing problems. Work will not be performed on a DFW until the preparatory and initial phase inspections have been completed and any nonconformance issues are resolved.

Definable Features of Work

The DFWs for the RI are as specified below and in Worksheet #17:

Preparatory Phase Inspection

The Preparatory Phase comprises the planning and design process leading up to the actual RI field activities. The UXOQCS or QC Geophysicist will perform a Preparatory Phase Inspection before beginning each DFW. The purpose of this inspection is to review applicable specifications and plans to verify that the necessary resources, conditions, and controls are in place and compliant before work activities start. Upon completion of the inspection, the UXOQCS or QC Geophysicist will complete the Preparatory Phase Inspection Report provided in Appendix D.

To perform the inspection, the UXOQCS or QC Geophysicist will review project plans and operating procedures. The UXOQCS or QC Geophysicist will verify that required plans and procedures have been approved and are available to the field staff; field equipment is appropriate, available, functional, and properly calibrated for its intended/stated use; staff responsibilities have been assigned and communicated; staff have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services have been made; training IAW the requirements of this QAPP has occurred; and the prerequisite mobilization tasks have been completed. As part of the Preparatory Phase Inspection, the UXOQCS or QC Geophysicist will verify that lessons learned during previous similar work have been incorporated, as appropriate, into the project procedures to prevent recurrence of past challenges.

Project staff must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the UXOQCS or QC Geophysicist during the Preparatory Phase Inspection. The UXOQCS or QC Geophysicist will verify that unsatisfactory and/or nonconforming conditions have been corrected in the approved plans before beginning work.

Initial Phase Inspection

The Initial Phase occurs at the startup of field activities associated with a specific DFW. At the onset of a DFW, the UXOQCS or QC Geophysicist will perform an Initial Phase Inspection and complete the QC Surveillance Report. The main objectives of the inspection are to check preliminary work for compliance with procedures and specifications, establish an acceptable level of workmanship, check for omissions, and resolve differences of interpretation. The Initial Phase Inspection will also verify that the APP adequately identifies all hazards associated with actual field conditions and that the APP promulgates the appropriate safe work practices. The Initial Phase Inspection results will also be documented by the UXOQCS or QC Geophysicist in the QC logbook and summarized in the QC Report as discussed in Worksheet #29. Should results of the inspection be unsatisfactory, the Initial Phase Inspection will be rescheduled and performed again. Refer to Table 31-1 and Worksheet #22 for the criteria that would result in an unsatisfactory Initial Phase Inspection.

During the Initial Phase Inspection, the UXOQCS or QC Geophysicist will ensure that discrepancies between site practices and approved plans or specifications are identified and resolved. The resolution of discrepancies is a critical step in the Initial Phase Inspection. As applicable, the appropriate Senior Technical Consultant (e.g., Senior Geophysicist, Project Chemist, SUXOS, Site Safety and Health Officer, CIH, etc.) will guide the Project Manager and project team members in resolving discrepancies. If discrepancies arise in establishing the baseline quality for a DFW, the responsibility for resolution falls to the Project Manager. If the discrepancy cannot be resolved in a manner that satisfies the project requirements, it will be elevated to the program level (i.e., to the Corporate QA/QC Officer) and a non-conformance report will be issued.

Follow-Up Phase Inspection

Completion of the Initial Phase of QC activity leads directly into the Follow-Up Phase, which covers the routine day-to-day activities at the site. The UXOQCS or QC Geophysicist will perform a Follow-Up Phase Inspection at regular intervals while a DFW is performed. This inspection ensures continuous compliance and verifies an acceptable level of workmanship. To conduct and document these inspections, the UXOQCS or QC Geophysicist will complete the QC Follow-Up Phase Inspection Checklist provided in Appendix D. The UXOQCS or QC Geophysicist will monitor on site practices and operations taking place and verify continued compliance with the specifications and requirements of this QAPP and approved amendments. Information documented on the Follow-Up Phase Inspection forms may be accompanied by Field QC Inspection Forms (Appendix D). The UXOQCS or QC Geophysicist will also verify that daily health and safety inspections are performed and documented as prescribed in the SSHP. Discrepancies between site practices and approved plans/procedures will be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices will be resolved by the UXOQCS or QC Geophysicist before continuing work.

Additional Inspections

Additional inspections performed on a DFW may be required at the discretion of USACE, the Project Manager, the SUXOS, the Corporate QA/QC Officer, or the UXOQCS or QC Geophysicist. Additional preparatory and initial inspections would be warranted under the following conditions: unsatisfactory work, as determined by EA or USACE, or NPS; changes in key personnel; resumption of work after a substantial period of inactivity (2 weeks or more); or changes to the project scope of work. These additional inspections will be documented on the appropriate inspection checklist forms and in the QC logbook.

Final Phase Inspection

The Final Phase Inspection is performed upon conclusion of the DFW and before closeout to verify that project requirements relevant to the particular DFW have been satisfied. Outstanding and nonconforming items will be identified and documented on the QC Surveillance Report provided in Appendix D.

Notification of Definable Features of Work and Three Phases of Control

The UXOQCS or QC Geophysicist will ensure that the three-phase control process is implemented for each DFW listed in Table 31-1. The assessment schedule and responsible parties for completing assessments are also provided in Table 31-1.

Audit Procedures

The Corporate QA/QC Officer is responsible for verifying compliance with this QAPP through audits and surveillance. The Project Manager is to inspect/audit the quality of work being performed for each DFW and verify that the work practices conform to specifications of this QAPP or other applicable guidance. Discrepancies are to be communicated to the responsible individual and documented in the QC logbook. Corrective actions are to be verified by the Corporate QA/QC Officer and recorded in the Daily QC Report.

PREVENTATIVE AND CORRECTIVE ACTIONS

The preventative and CAs incorporated within this QAPP are designed to prevent and correct quality problems that may arise during the RI. The procedures facilitate process improvements and describe the available mechanisms to identify, document, and track discrepancies until a corrective action has been verified.

Preventive Measures

While the entire QC program is directed toward problem prevention, certain elements of the program have greater potential to be proactive. The primary tools for problem prevention on this project are Three Phases of Control (Section 31.1.1). Should these preventive measures fail, tracking and communicating discrepancies also provides a mechanism for preventing recurrence.

Continual Improvement

A continual improvement process will be implemented for the project. Project staff at all levels will be encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner. Typical quality improvement recommendations include identifying an existing practice that can and should be improved (such as a bottleneck in production) and/or recommending an alternative practice that provides a benefit without compromising prescribed standards of quality. Project staff should bring their recommendations to the attention of the SUXOS or UXOQCS or QC Geophysicist through verbal or written means. Deviations from established protocols are not to be implemented without prior written approval from appropriate personnel.

Deficiency Identification and Resolution

While deficiency identification and resolution occur primarily at the operational level, QC audits provide a backup mechanism to address problems that either are not identified or cannot be resolved at the operational level. Through implementation of the audit program prescribed in this QAPP, the Project Manager is responsible for verifying that deficiencies are identified and documented as prescribed herein and corrected in a timely manner. Deficiencies are to be corrected by operational staff and documented by the UXOQCS or QC Geophysicist.

Corrective Action Request

A CAR can be issued by any member of the project team, including subcontractor employees. If the individual issuing the CAR is also responsible for correcting the problem, then he/she should document the results on Part B of the CAR. Otherwise, the CAR should be forwarded to the Project Manager, who is then responsible for evaluating the validity of the request, formulating a resolution and developing a corrective strategy, assigning personnel and resources, and specifying and enforcing a schedule for corrective actions. Once a CA has been completed, the CAR and supporting information will be forwarded to the Corporate QA/QC Officer for closure. Sufficient information will be provided to allow the QC reviewer to verify the effectiveness of the CAs.

The recommendations provided in the CAR and implemented in this QAPP will be reviewed during Follow-Up QC inspections. The purposes of this CAR review are to ensure that established protocols are implemented properly, verify that corrective action commitments are met, ensure that corrective actions are effective in resolving problems, identify trends within and among similar work units, and facilitate system root cause analysis of larger problems.

The Corporate QA/QC Officer will determine whether a written CA Plan is necessary, based on whether or not any of the following are met: the CAR priority is high, deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency, or deficiency requires extensive resources and planning to correct the deficiency and to prevent recurrence. The CA Plan will be developed by the Project Manager and approved and signed by the Corporate QA/QC Officer. The CA Plan will indicate whether it is submitted for informational purposes or for review and approval. In either event, operational staff is encouraged to discuss corrective action strategy with the UXOQCS or QC Geophysicist throughout the process.

Corrective Action Request Tracking

Each CAR must be given a unique ID number and tracked until corrective actions have been implemented in the field, documented in Part B of the CAR (Appendix D; D-3), and the CAR is submitted to the Project Manager for verification and closure.

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The type, frequency and parties responsible for planned assessment activities to be performed for the project are summarized in the tables below.

Table 31-1 Assessment Schedule

Assessment Type	Frequency	Responsible Party	Assessment Deliverable	Responsible for Responding to Assessment Findings	Assessment Response Documentation and Timeframe
Pre-Mobilization-Establishment of GIS	Once prior to mobilization.	GIS Manager	Memo/email	GIS technician	Memo/email/10 business days after notification
Mobilization of personnel and equipment	Once during mobilization.	UXOSO/QCS	Initial and Follow-up Phase Inspection Checklist	SUXOS	Memo/email/3-5 business days after notification
Site-specific training	Once (for each new personnel, throughout field operations).	UXOSO/QCS and QC Geophysicist	Preparatory Phase Inspection Checklist	SUXOS	Memo/email/3-5 business days after notification
Establish Control Points	Once at beginning and weekly inspections during survey operations.	UXOQCS	Initial and Follow-up Phase Inspection Checklist	Survey team lead	RCA/24 hours after notification
Grid/transect stakeout	Once during Initial and Follow-Up Phases (weekly inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	Survey team lead	RCA/24 hours after notification
Surface Clearance of Grids	Once during Initial and Follow-Up Phases (weekly inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	SUXOS	RCA/24 hours after notification
Brush Cutting on DGM Transects/grids	Once during Initial and Follow-Up Phases (weekly inspections during survey operations).	UXOQCS/Site Geophysicist	Initial and Follow-up Phase Inspection Checklist	Brush cutting team lead	Memo/email/24 hours after notification
Establish IVS/Blind Seeding	Once during Initial and Follow-Up Phases (weekly inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist/SOP checklist	SUXOS	RCA/24 hours after notification
DGM equipment assembly/perform IVS	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS and QC Geophysicist	Initial and Follow-up Phase Inspection Checklist/SOP checklist	DGM site geophysicist/project geophysicist	RCA/24 hours after notification
Land DGM Data Collection	QC Geophysicist inspects during Initial and Follow-Up Phases (daily inspections by QC Geophysicist).	QC Geophysicist	Initial and Follow-up Phase Inspection Checklist/SOP checklist	DGM site geophysicist/project geophysicist	RCA/24 hours after notification
AGC equipment assembly/perform IVS	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS and QC Geophysicist	Initial and Follow-up Phase Inspection Checklist/SOP checklist	AGC site geophysicist/project geophysicist	RCA/24 hours after notification
Land AGC Data Collection	QC Geophysicist inspects during Initial and Follow-Up Phases (daily inspections).	QC Geophysicist	Initial and Follow-up Phase Inspection Checklist/SOP checklist	AGC site geophysicist/project geophysicist	RCA/24 hours after notification
Intrusive Investigation of Land-Based DGM Anomalies	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	SUXOS	RCA/24 hours after notification
Dive Operations	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	Dive Supervisor	RCA/24 hours after notification
MPPEH Management	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	UXO team lead	RCA/24 hours after notification
Demolition	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	SUXOS/Dive Supervisor	RCA/24 hours after notification
Site Restoration	Once during Initial and Follow-Up Phases (daily inspections during survey operations).	UXOQCS	Initial and Follow-up Phase Inspection Checklist	SUXOS	RCA/24 hours after notification
Data Management	Once during Initial and Follow-Up Phases (weekly inspections during survey operations).	UXOQCS and QC Geophysicist	Initial and Follow-up Phase Inspection Checklist	Data manager/project geophysicist	Memo/email/3–5 business days after notification

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QAPP Worksheet #34: Data Verification and Validation Inputs

This worksheet lists the inputs that will be used during data verification, validation and usability assessment. Inputs include all requirement documents, field records, and interim and final reports. Data verification is a check that all specified activities involved in data or sample collection and analysis have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs and Worksheet #22. The DUA is an evaluation of the data set making up a delivery unit, to determine whether the data support their intended uses. It is an evaluation of conformance to the MPCs presented in Worksheet #12.

Requirements/Specifications:

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Planning Documents/Records				
1	Approved UFP-QAPP	X		
2	Contract	X		
3	Field SOPs	X		
Field Records				
4	Field logbooks	X		
5	Photographs	X		
6	Checklist for Out of Box Equipment Test	X	X	
7	IVS construction details	X	X	
8	Instrument assembly checklist (Detection survey)	X	X	
9	Instrument assembly checklist (Cued survey)	X	X	
10	Sensor function test results (Detection survey)	X	X	
11	Sensor function test results (Cued survey)	X	X	
12	IVS checklists	X	X	
13	Cued survey data collection QC checklist	X	X	
14	Cued survey data processing QC checklist	X	X	
15	Field Data Sheet	X	X	
16	Digital Field Notes	X		

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
17	Preparatory Phase/Initial Phase/Follow-up Phase and Final Inspection Checklists	X	X	
18	Daily QC reports	X	X	
19	Field Change Requests	X	X	
20	CARs	X	X	X
Electronic Data				
21	Raw EM61 (. R61/M61) data files	X	X	
22	Converted EM61 (ASCII.xyz) files	X	X	
23	Data Processing and QC Log	X	X	X
24	Geosoft Mapped Detection Data (GDB, MAP)	X	X	X
25	Dig Packages	X	X	
26	Final Data Archive	X	X	
27	Final ranked dig list (Cued survey)			X
28	Final data archive (Cued survey)	X	X	
Interim and Final Reports/Deliverables				
29	QC Seed Log	X	X	X
30	GIS Deliverable	X	X	X
31	IVS memorandum			X
32	Classification images	X		
33	Site-specific library			X
34	Cued survey QC report			X
35	Final ranked dig list (Cued survey)			X
36	Target classification report			X
37	Draft verification and validation plan			X
38	Final verification and validation plan			X

QAPP Worksheets #35A: Data Verification Procedures, MEC Investigation

Procedures that will be used to verify and validate 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
General Field Documentation	UFP-QAPP	Verify that records are present and complete for each day of field activities and any required signatures are present.	UXOQCS; SUXOS; PM	Site manager logbook Daily status reports Weekly QC reports Equipment and Instrument check logs
QC Blind Seeding	UFP-QAPP; ANJV SOP 3	Seed items are buried IAW specifications in QAPP Appendix F (SOP 17). Seed item details (ID, type, orientation, depth and recovery) are documented and items are photographed prior to burial. Seed item locations are surveyed and covered prior to geophysical data collection.	UXOQCS; Project Geophysicist	Daily QC Report; Digital seeding log (.XLS or .CSV) tabulated seed details and locations.
Preparatory Phase/ Initial Phase/ Follow-up Phase and Final Inspection Checklists	UFP-QAPP; Appendix G	All inspection forms are complete for each DFW.	UXOQCS	QC inspection forms in QAPP Appendix G
Daily QC Report	UFP-QAPP; Appendix G	All QC reports are complete for each field day/week.	UXOQCS	QC report forms in QAPP Appendix G
IVS Construction and Survey at IVS	UFP-QAPP; ANJV SOP 2, ANJV DGM SOP 1	Initial IVS has been constructed and surveyed according SOPs. All specifications have been achieved, or exceptions noted. If appropriate, CAs have been completed.	ANJV Field Geophysicist; ANJV Project Geophysicist USACE QA Geophysicist	IVS Letter Report SOP checklists

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person(s)	Documentation
Data Collection (DGM Survey)	UFP-QAPP; ANJV SOP DGM 1	Verify daily QC checks are documented for each DGM team. Detailed field notes are recorded. Raw data is submitted to the data processing center daily and MQOs have been achieved. If required, RCAs and CAs have been completed. Field Geophysicist performs and documents submittals.	ANJV Field Geophysicist; ANJV QC Geophysicist; UXOQCS	Raw data files; Project Database (Access); Background location report; Daily QC report
DGM Survey Data Processing	UFP-QAPP; ANJV SOP DGM 2	Detection survey data processing has been completed according to SOPs. Seed performance has been conducted. All specifications have been achieved, or exceptions noted. If appropriate, CAs have been completed.	ANJV Field Geophysicist; ANJV QC Geophysicist; ANJV Data processor; USACE QA Geophysicist	Processed data files; Project Database; Weekly QC report; QC seed tracking log; Dig Package
Geophysics Field Documentation	UFP-QAPP Appendix G	Verify that records are present and complete for each day of field activities and any required signatures are present. Ensure results of all relevant MPCs are attained and correctly documented.	ANJV Field Geophysicist; ANJV QC Geophysicist; UXOQCS	Field logbook Daily QC reports Weekly QC reports Equipment and Instrument check logs
Instrument Assembly (Cued Survey)	UFP-QAPP; ANJV SOP 1MM2/1T	Verify detection system has been assembled IAW ANJV SOP 1MM2/1T and MQOs have been achieved. Signatures and dates are present.	ANJV Field Geophysicist; ANJV QC Geophysicist	SOP checklists Daily QC report
Establish IVS and Initial IVS (Cued Survey)	UFP-QAPP; ANJV SOP 2	Initial IVS Survey has been conducted according to the GSV Plan and documented in the IVS Letter Report. All specifications have been achieved, or exceptions noted. The IVS Report has been approved by the QA Geophysicist. Signatures and dates are present.	ANJV Field Geophysicist; ANJV Project Geophysicist USACE QA Geophysicist	IVS Letter Report SOP checklists
Data Collection (Cued Survey)	UFP-QAPP; ANJV SOP 6/7	Verify daily QC checks are documented for each AGC team. Detailed field notes are recorded. Raw data is submitted to the data processing center daily and MQOs have been achieved. If required, RCAs and CAs have been completed. Field Geophysicist performs and documents submittals.	ANJV Field Geophysicist; ANJV QC Geophysicist; UXOQCS	Raw data files; Project Database (Access); Background location report; Daily QC report

Activity and Records Reviewed	Requirements/ Specifications	Process Description/Frequency	Responsible Person(s)	Documentation
Data Processing (Cued Survey)	UFP-QAPP; ANJV SOP 8	For each Dataset: Quality requirements are documented in the Project Database. Processed data and anomaly characteristics and classification are posted for QC review. QC review and submittal to QA occur on a dataset basis within one week of data collection. MQOs have been achieved for seed classification performance, with any exceptions noted. If required, RCAs and CAs have been completed. Verify site-specific library meets MQOs prior to classification.	ANJV Field Geophysicist; ANJV QC Geophysicist; ANJV Data processor; USACE QA Geophysicist	Processed data files; Project Database; Weekly QC report; Site specific library; QC seed tracking log; Final ranked dig list
Completed Dig Packages	UFP-QAPP; MR SOP 14	Intrusive investigation data has been captured in completed dig packages for survey area.	Project Geophysicist, UXOQCS, Database manager	Microsoft Excel dig sheets, MS Access project database, FUDSChem
Intrusive Investigation (Validation Digs and TOI Digs)	UFP-QAPP; ANJV SOP 9; ANJV SOP10;	Verify all intrusive results contain all anomalies listed as “Dig” on the final ranked dig list along with all validation digs. Ensure dig sheets are complete and contain information to adequately describe the dig results. All specifications have been achieved, with any exceptions noted. If required, RCAs and CAs have been completed.	ANJV QC Geophysicist; UXOQCS	Intrusive results; Daily QC reports; Final ranked dig list

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QAPP Worksheet #35B: Data Verification Procedures, MC Investigation (if required)

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #36: MC Data Validation Procedures (if required)

MC sampling is not anticipated during the RI; therefore, this worksheet is not required to support the RI field effort.

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QAPP Worksheet #37: Data Usability Assessment, MEC Investigation

This worksheet documents procedures that will be used to perform the DUA for each stage of investigation namely, dynamic detection survey, cued survey and intrusive investigation. The DUA will be performed as part of the RI Report, 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 members of the project team listed below. The DUA evaluates whether underlying assumptions used during systematic planning for DGM operations 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:

- EA Project Manager, Tim Reese.
- EA Geophysics Program Lead, Mike McGuire
- EA Project Chemist, Samantha Saalfield
- ANJV Corporate QAM (AGC), Dean Keiswetter
- ANJV Project Geophysicist (AGC), Alex Kostera
- ANJV QC Geophysicist (AGC), Ben Dameron
- ANJV Field Geophysicist (Lead), Mark Howard
- AOR Dive Supervisor, TBD
- USACE (New England District) Project Manager, Erin Kirby
- USACE (Baltimore District) Technical Manager, Todd Beckwith
- USACE (Baltimore District) Geophysicist, David King
- USACE (Environmental and Munitions Center of Expertise) Geophysicist, John Jackson

Documents used as input to the DUA include the following:

- UFP-QAPP
- QASP
- Contract specifications
- Daily and weekly QC Reports
- CARs
- IVS Letter Report
- Processed data files
- Project Database
- GIS Deliverable
- Data verification/validation reports
- Field documents.

Data usability will be discussed in the RI Report. 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.

- **Step 2: Review the data verification and data validation outputs and evaluate conformance to MPCs documented on Worksheet #12.** Review the site-specific project library for completeness. Review available QA/QC reports, including assessment reports, CA Reports, and the data validation report. Evaluate the implications of unacceptable QC results. Evaluate conformance to MPCs documented on Worksheets #12 and #22. Summarize the impacts of non-conformances on data usability.

- **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. Update the CSM 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 future similar studies. Prepare the data usability summary report.

EA's PM will be responsible for information in the DUA. He will also be responsible for assigning task work to the individual task members who will be supporting the DUA.

Each of the MPCs listed in Worksheet #12 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 DQOs 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.

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Appendix A

TPP #1 Meeting Minutes

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FORMER IONA ISLAND NAVAL AMMUNITION DEPOT STONY BROOK, NEW YORK

Technical Project Planning (TPP) Meeting #1

BUILDING STRONG®

TPP Meeting Objectives

- Purpose of this TPP meeting is to:
  - Gain a common understanding of the site history
  - Facilitate discussion and understanding of stakeholder concerns
  - Achieve concurrence on project objectives
  - Understand project constraints/dependencies
  - Present Conceptual Site Model (CSM) and proposed approach
  - Outline the next steps of the project
- Results of this meeting will be used to shape Project Plans.
  - Early planning and communication will facilitate progress towards site close-out

Technical Project Planning

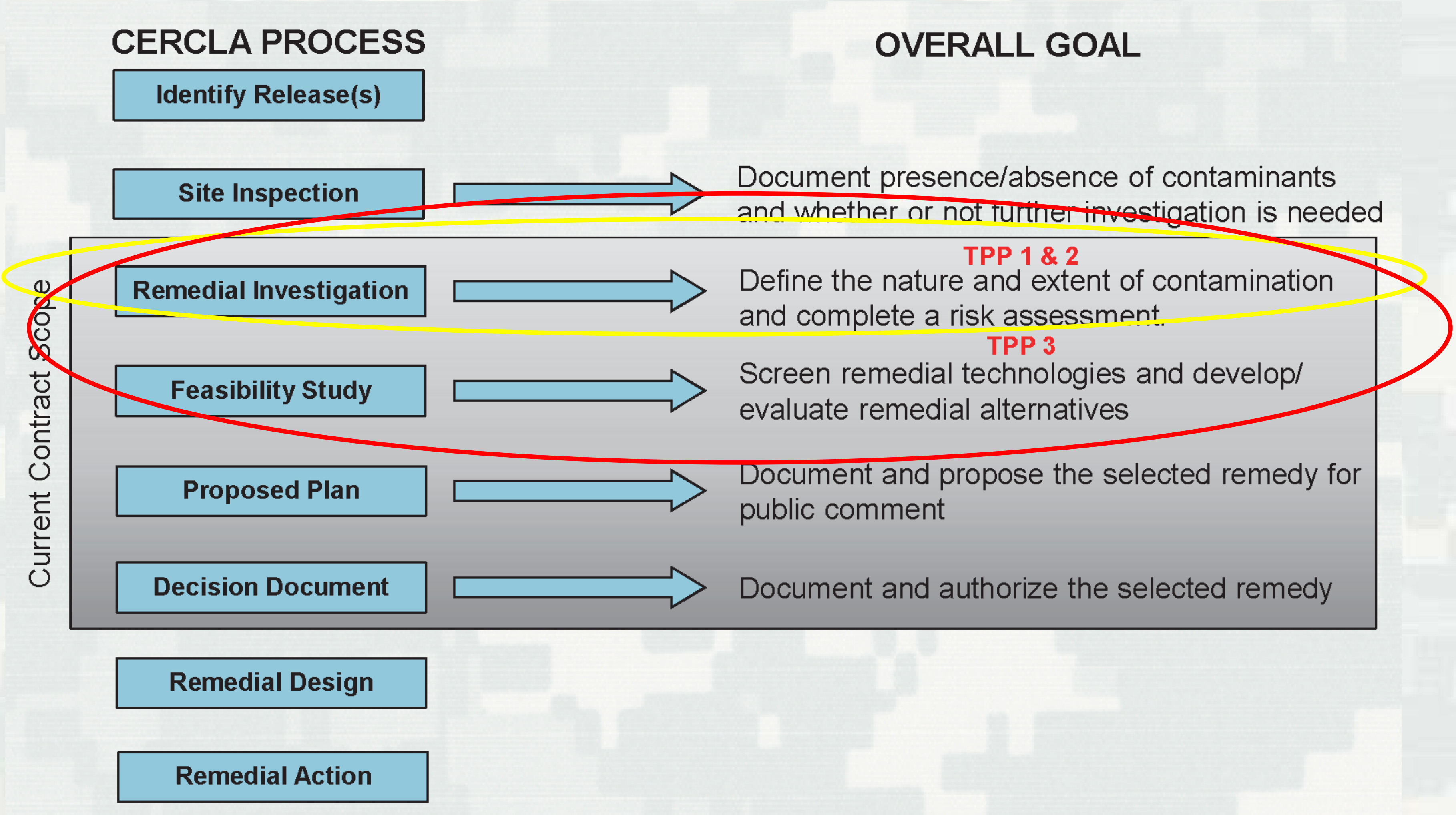
TPP is a four-phase process:

- ❑ **Phase I – Identify the project**
  - Stakeholders?
  - Project definition/CSM?
  - Customer goals?

- ❑ **Phase 2 – Determine data needs**
  - What *do* we know?
  - What *don't* we know?

- ❑ **Phase 3 – Develop data collection options**
- ❑ **Phase 4 – Finalize data collection program**
  - How best to get the information we need?

CERCLA Process



Note: *CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act*

Scope and Objectives

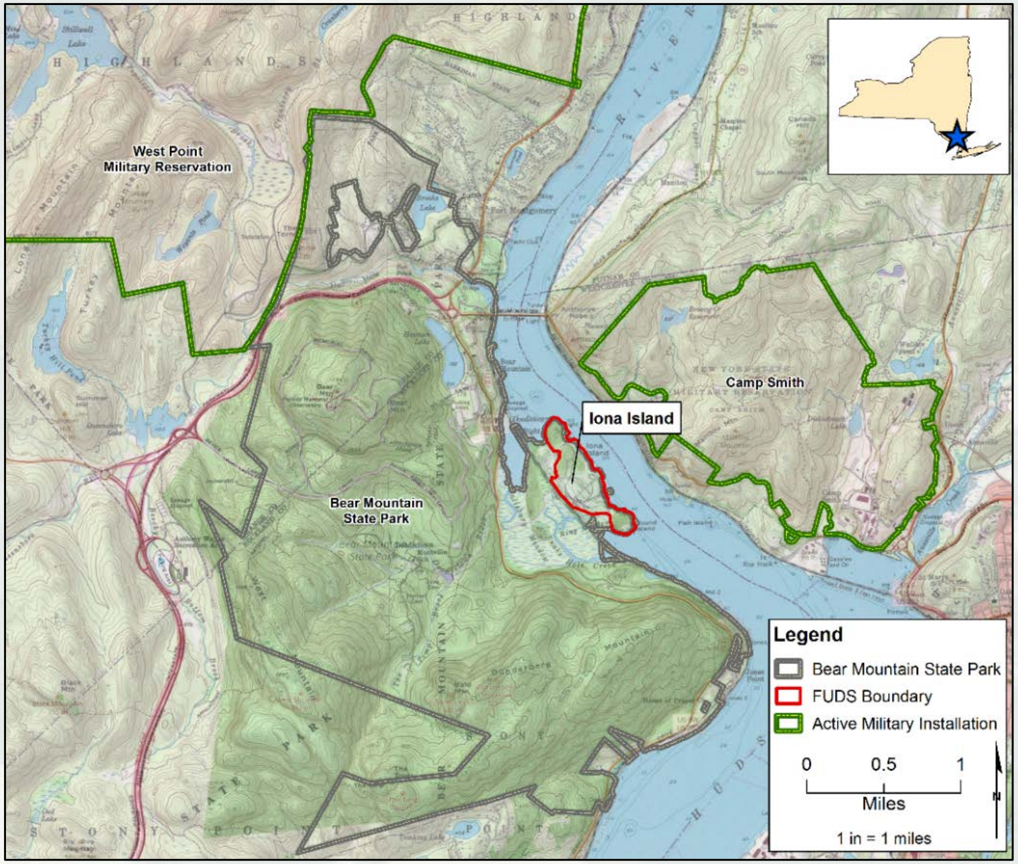
- Project Scope
  - Achieve Decision Documents at the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS) for;
    - ✓ Munitions Response Site (MRS), MRS-01 1903 Explosion
    - ✓ 19 Hazardous, Toxic, and Radioactive Waste (HTRW) Areas of Concerns (AOCs)

- Project Objective:
  - Complete RIs for MRS-01 1903 Explosion and the 19 HTRW AOCs

- Note: *Installation Restoration Program (IRP) AOCs are referred to as HTRW AOCs for the remainder of the presentation.*

Site Location and Background

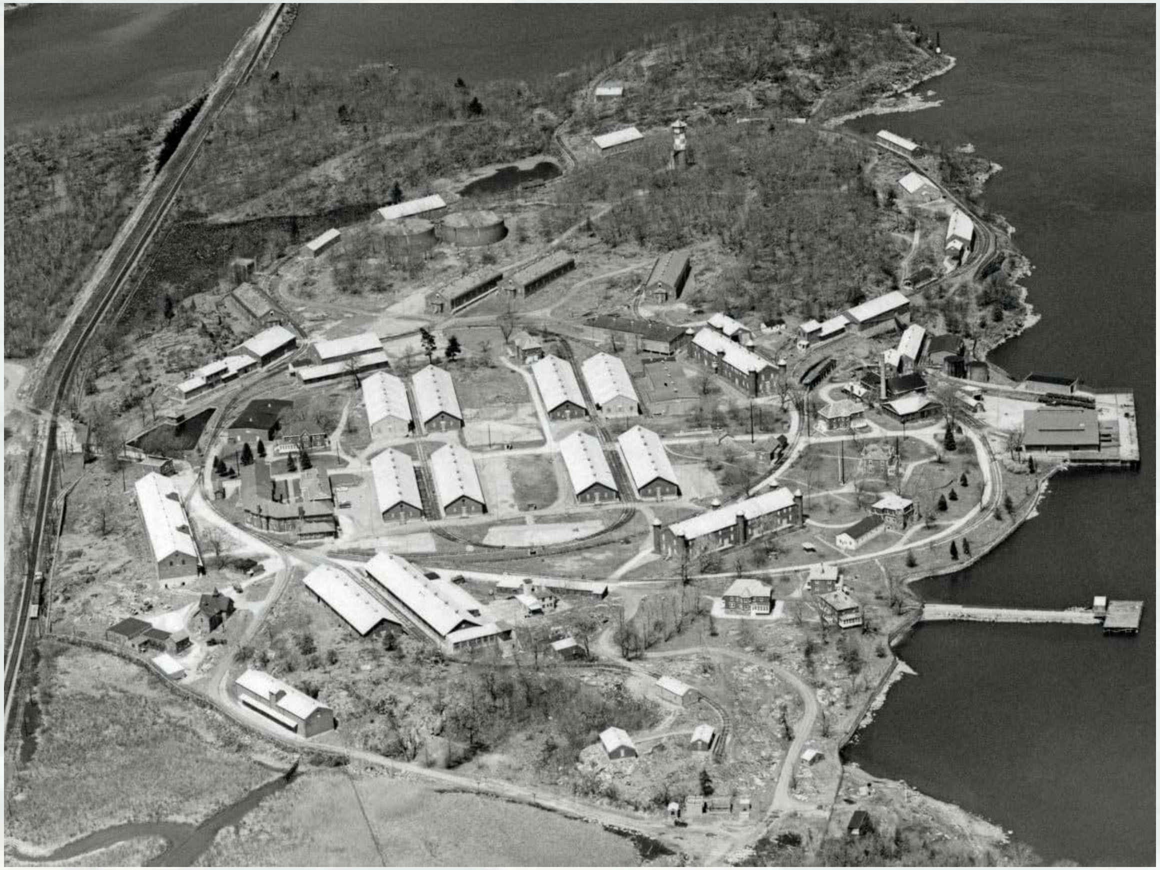
- Iona Island and Round Island along the Hudson River in the town of Stony Brook, Rockland County, NY
- 124.2 acres of land and inland water
- Currently owned by the Palisades Interstate Park Commission (PIPC); maintained by Bear Mountain State Park



BUILDING STRONG®

Site History

- Used by Navy between 1900 and 1947: Naval Ammunition Depot
- 146 buildings on the island in 1951 when the installation was deactivated
- Majority of buildings and structures have been demolished



Site History

- Preparing, assembling, maintaining, inspecting and testing ammunition
- Storage of bulk explosives, ammunition and ordnance material
  - World War I (WWI) and WWII munitions
  - Loaded ~4,600 ships during WWII

Physical Environment

- Land, tidal wetlands, and river environments are all present
- Shallow soil overlying bedrock
- Majority of native soil has been disturbed
- Perched groundwater
- Surface water flow to Doodletown Brook, Snake Hole Creek, Hudson River
- Hudson River is tidally influenced (~3.5 feet), maximum depth of 143 feet close to Iona Island

Site Use and Potential Receptors

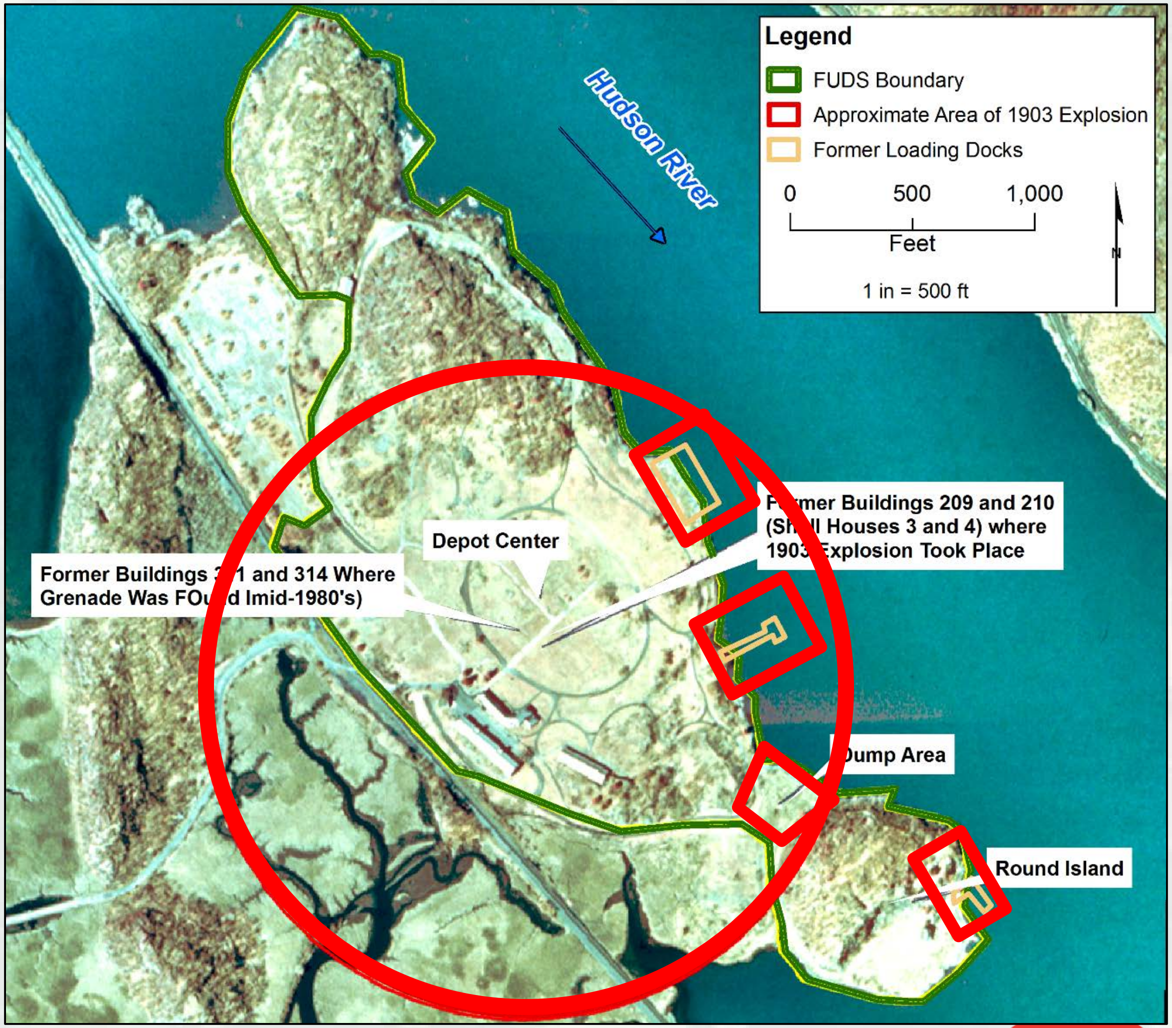
- Status of areas/land use is limited to Park offices/storage, conservation, research and recreation
- Access to the island is restricted/limited; future use is not anticipated to deviate from current use
- Human receptors: recreational users/trespassers, construction workers, park employees and researchers
- Ecological receptors: sensitive environments (tidal wetlands/marsh), threatened and endangered species

MMRP Previous Investigations

- Historically, various munitions-related items found
  - During low water, ordnance items have been reported along the eastern shoreline near “dump area”
  - Munitions Debris (MD)
    - grenade found near Bldg. 311 and 314
    - small arms cartridge casings
    - 6-pound projectile cartridge case
    - signal flare
    - portion of a 3.75-inch rocket warhead
- 2007 Site Inspection: no Munitions and Explosives of Concern (MEC) or MD identified during field reconnaissance; no explosives detected (only metals).

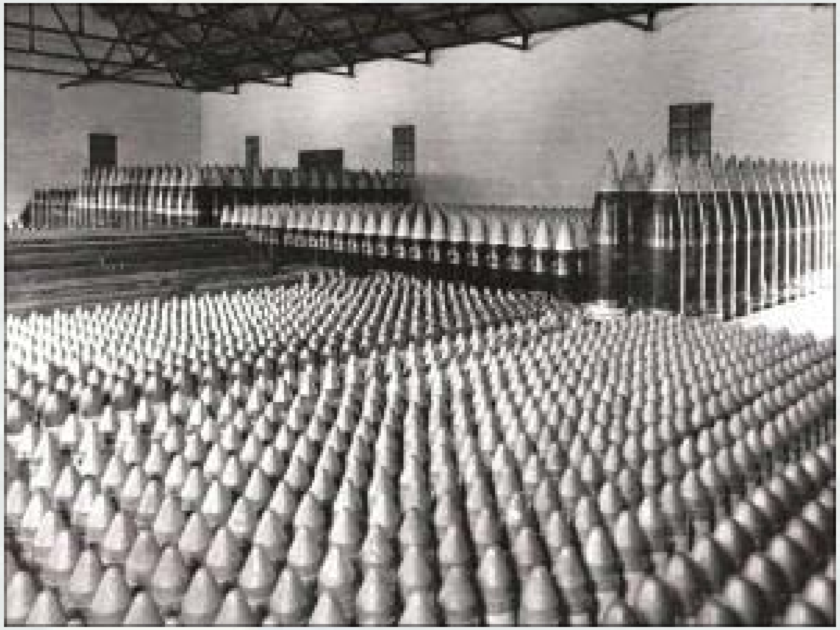
MMRP Investigation Overview

- ***3 Areas***
  - MRS-01 1903 Explosion area (approximately 124.2 acres)
  - Former loading docks and downstream shoreline
  - Dump area between Iona Island and Round Island



MMRP Data Gaps

- MRS-01 1903 Explosion area has not been fully delineated/investigated in regards to horizontal and vertical extent of MEC
- Loading dock areas have not been characterized
- Dump area has not been characterized
- Potential MEC present at Iona Island based on historical information/previous investigations and includes:
  - 13-inch shells, 1-pounders, 6-pounders, and 6-inch ammunition distributed throughout the land, water, or wetland areas from the MRS-01 1903 Explosion area



MMRP Data Quality Objectives (DQOs)

1) **State the Problem**
   - MEC may be present as a result of historical activities at the MRS/FUDS.
   - MC (explosives and metals) may be present where breached MC is found.

2) **Goal**
   - Determine the horizontal and vertical extent of MEC/MC.

3) **Inputs**
   - MEC
     - ✓ Previous investigations.
     - ✓ Digital Geophysical Mapping (DGM) transects and grids.
     - ✓ Cued Advanced Geophysical Classification (AGC) survey.
     - ✓ Intrusive investigation on land of targets interest.
     - ✓ Intrusive investigation in water at former loading docks.
   - MC
     - ✓ Analytical data (explosives) if breached MEC is discovered.

MMRP DQOs (Cont'd)

4) Boundaries

- RI areas for investigation are based on calculations of maximum kick-out area (MRS-01 1903 Explosion), historical photographs (debris / dump area), and maps (former docks and shoreline).

5) Analysis Approach

- Delineate and characterize MEC in MRS-01 1903 Explosion area Identify and characterize disposal areas
- Identify and characterize MEC in water around loading docks
- Identify and characterize MEC along shoreline downstream of loading docks
- Characterize MC (if source is identified)

MMRP DQOs (Cont'd)

6) Performance/Acceptance Criteria

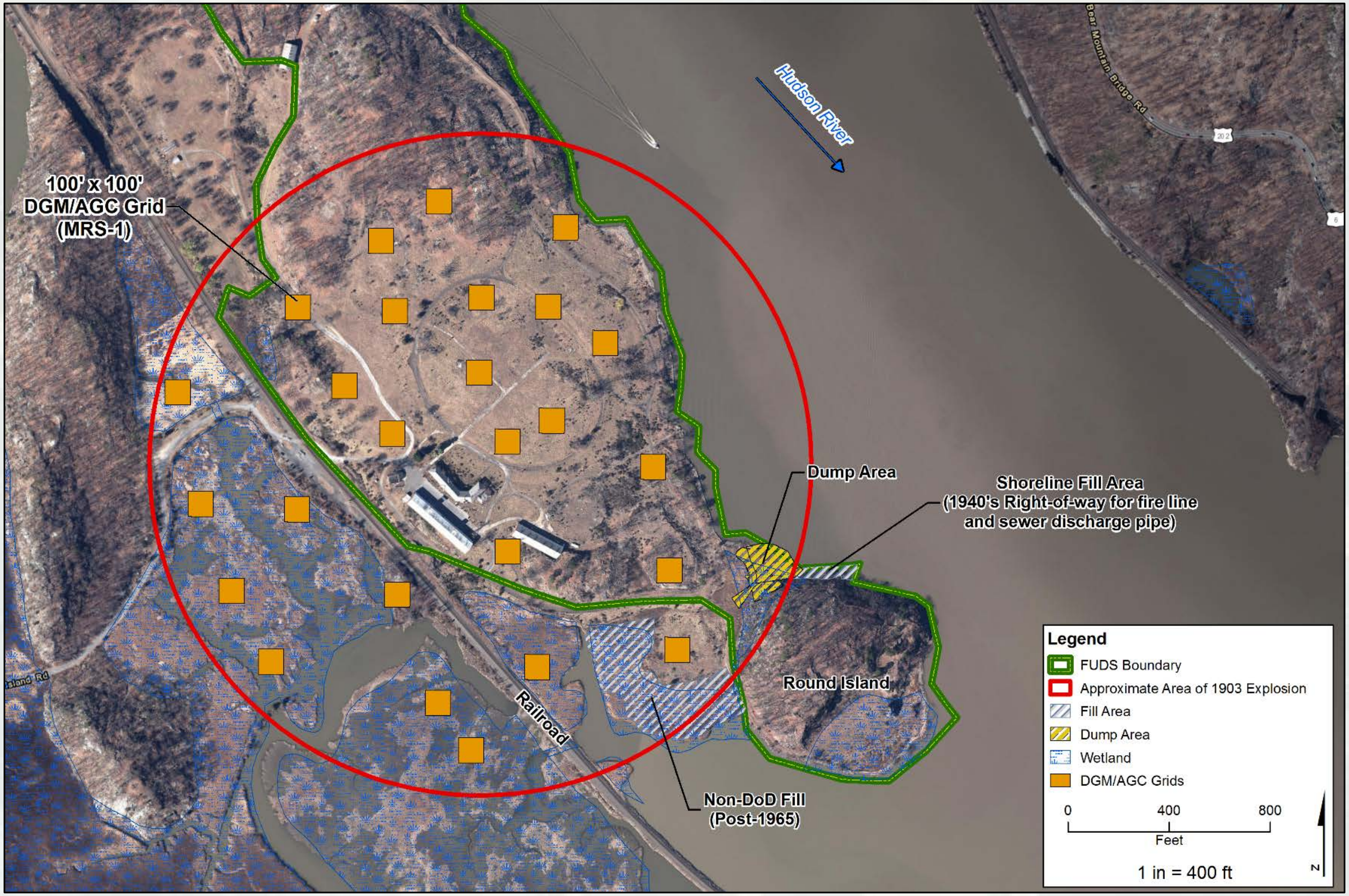
- MEC
  - Engineering Manual (EM) 200-1-15 and AGC QAPP templates to develop measurement and performance criteria (MPCs) used for the investigation
- MC
  - Laboratory Method Detection Limits/Reporting Limits for explosives and metals

7) Develop Plan for Obtaining Data

- Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP)

- Definable Features of Work (DFWs)

Proposed MMRP RI Approach



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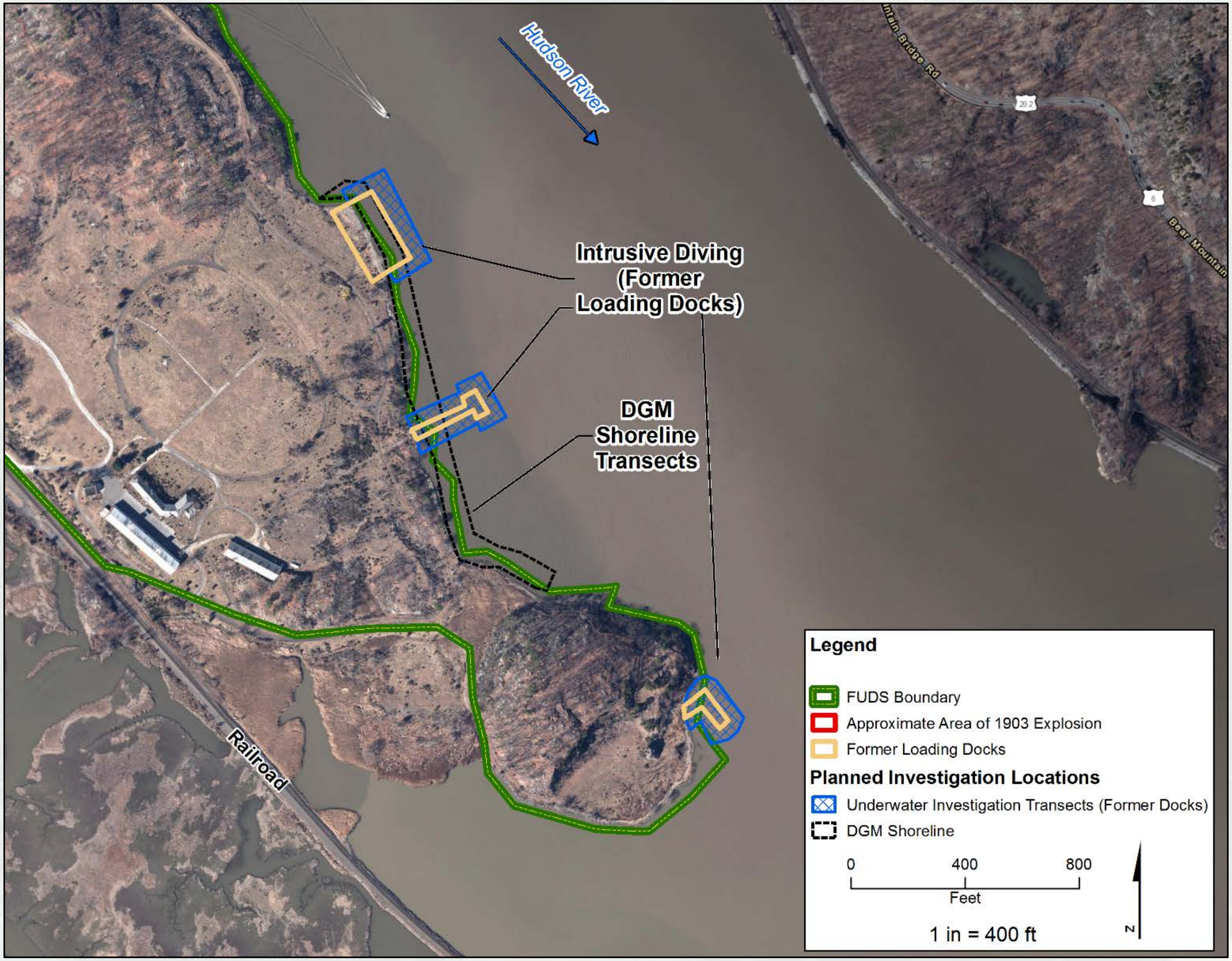
Proposed MMRP RI Approach

Proposed MMRP RI Approach



Proposed MMRP RI Approach

Phase 1

- Land DGM Survey over accessible portions of MRS-1, Hudson River shoreline, and likely “dump site”

Evaluation

- DGM Data Analysis, Target Anomaly Identification, Potential Disposal Feature Identification
- Select Target Anomalies for AGC
- Review Results with PDT (TPP #2)

Phase 2

- Data Collection of Selected Target Anomalies utilizing Advanced Geophysical Classification

Evaluation

- Advanced Geophysical Classification Data Analysis
- Generate “dig list” targets for Intrusive Investigation
- Review Results with PDT (TPP #3)

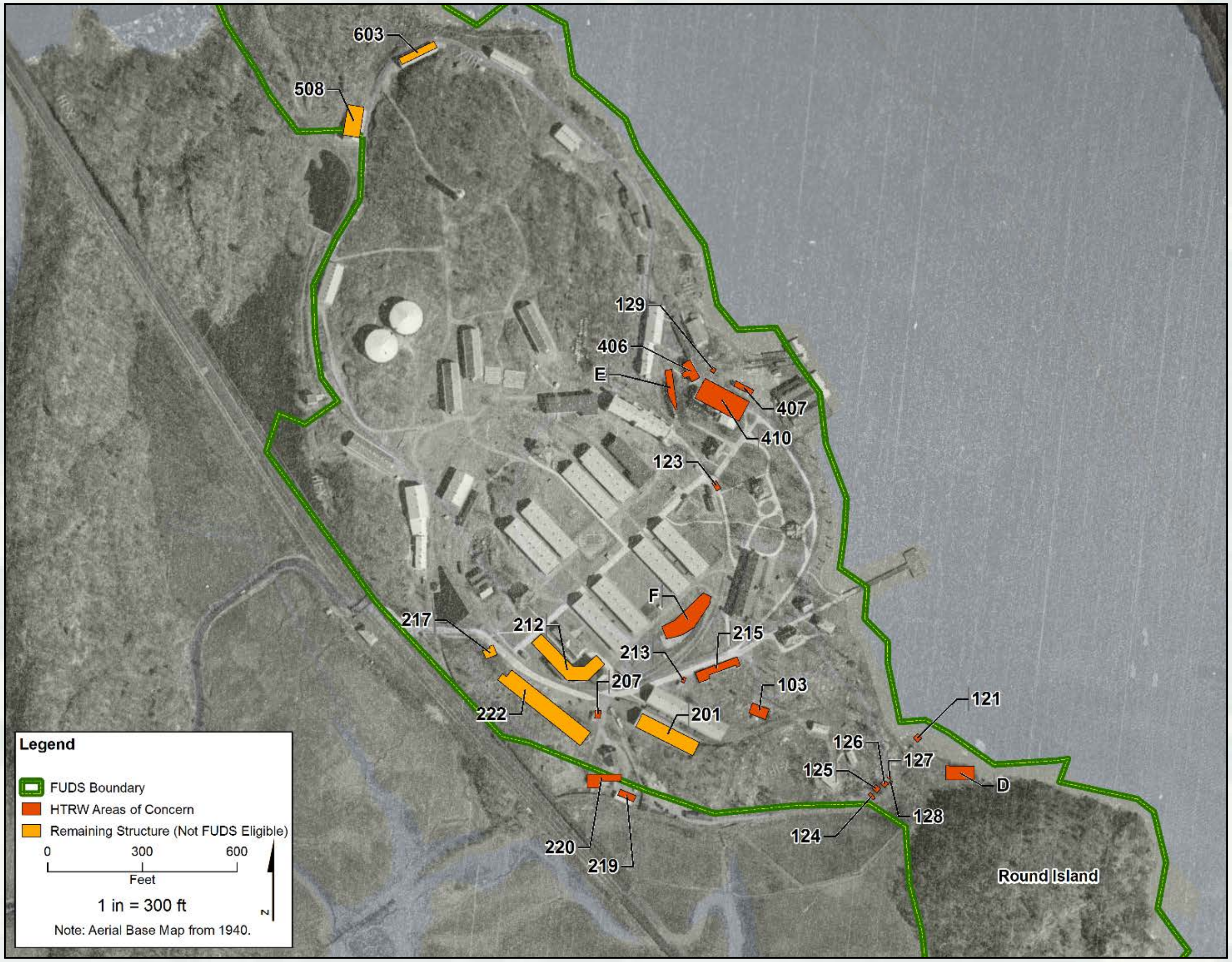
Phase 3

- Reacquire and Intrusively Investigate “dig list” targets
- Intrusively Investigate Potential Disposal Feature
- “Mag & Dig” portions of MRS-1 not suitable for DGM/AGC
- Dive on Hudson River Docks

Evaluation

- Review Results with PDT (TPP #4)

HTRW Overview

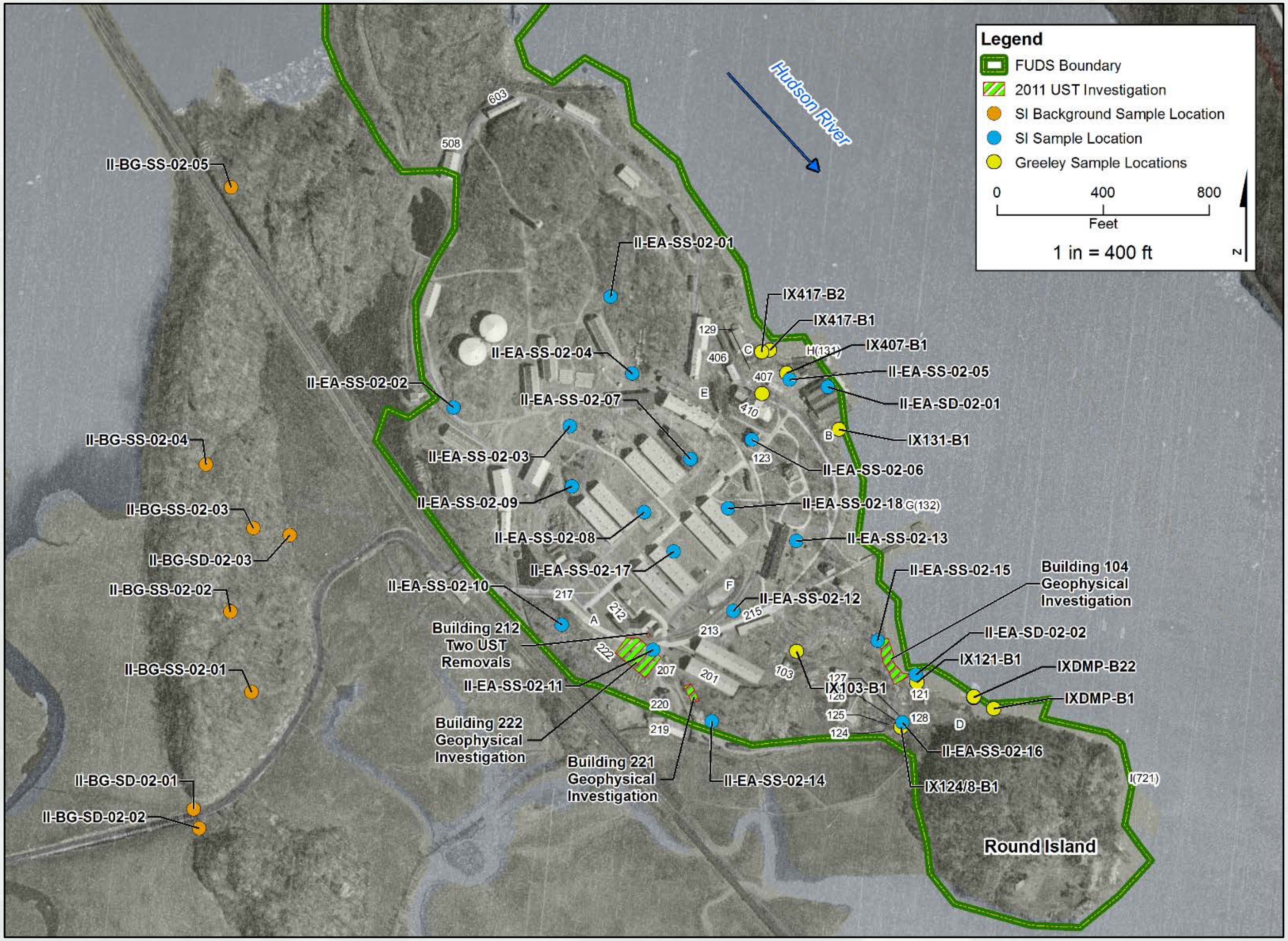


- Historical information and previous investigations document 16 AOCs
  - ➢ Historical activities and dumping may have resulted in the release of contaminants to surface soil.

HTRW Previous Investigations

- Many areas of Iona Island are influenced by the Hudson River, including shoreline and adjoining wetlands
- Previous investigations focused on former structures (buildings, USTs/ASTs, and storage areas) and suspected dumping area
- Existing soil data for metals and SVOCs (PAHs)
- Full COPC list will be developed and included in QAPP

HTRW Previous Investigations - Soil Sampling



HTRW Potential Data Gaps

- Extent of COPCs has not been delineated
- No previous subsurface soil or groundwater sampling
- No previous biota sampling or toxicity testing
- Verify federal and state threatened/endangered species status
- Request for Section 106 Consultation
- Conduct human health and ecological risk assessments

HTRW DQOs

1) **State the Problem**
   - Contamination may have been released as a result of historical DoD activities
   - Concentrations may pose a risk to human health and ecological receptors

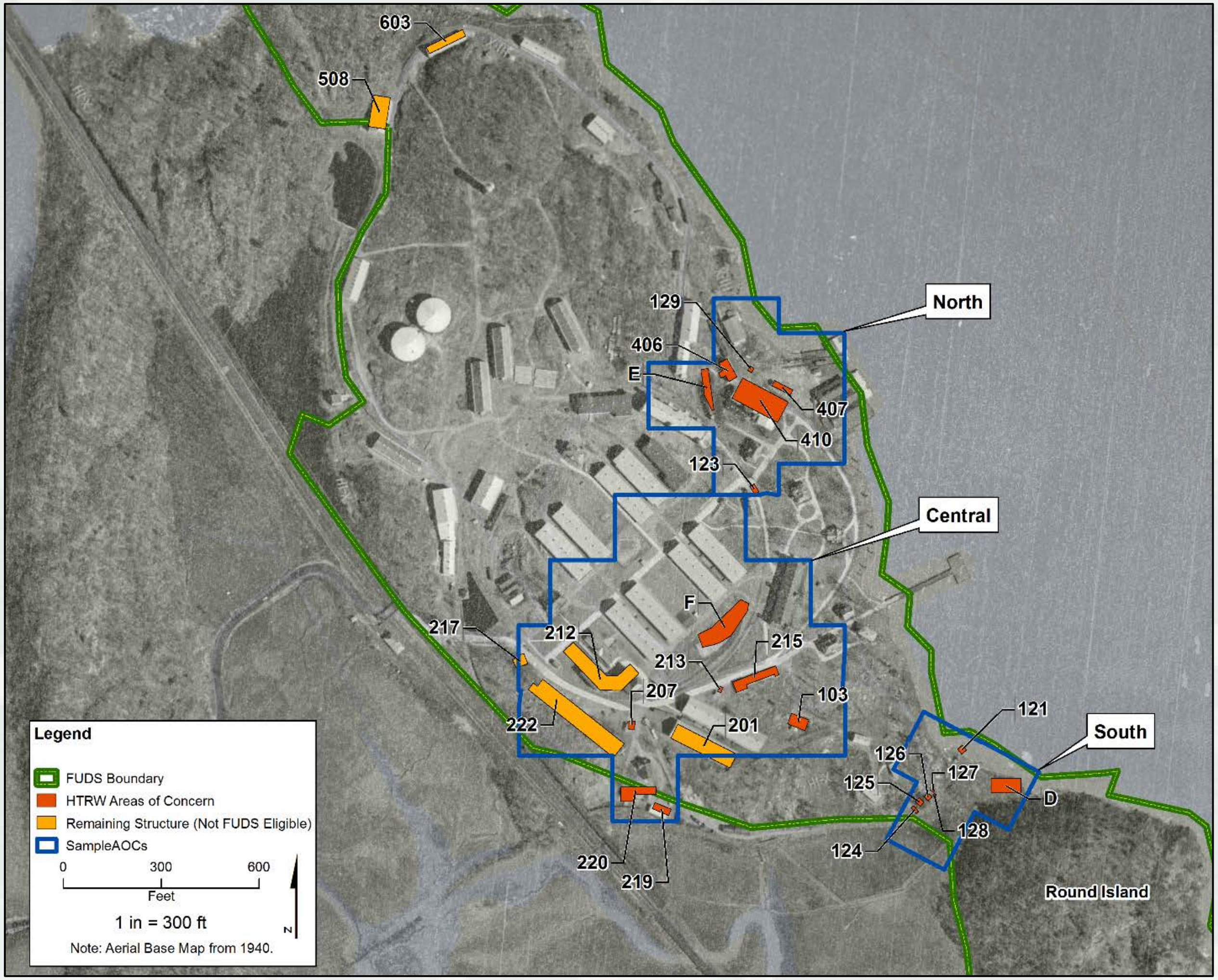
2) **Goal**
   - Determine if COPCs are present above available human health and ecological screening risk levels
   - Perform a Human Health Risk Assessment (HHRA)
   - Perform a Screening-Level Ecological Risk Assessment (SLERA)

1) **Inputs**
   - Historical use/operations and investigations at Iona Island
   - United States Environmental Protection Agency (EPA) regional screening levels (RSLs)
   - Ecological screening levels

HTRW DQOs (Cont'd)

4) Boundaries

- 16 AOC locations grouped into 3, larger AOC groupings (North, Central and South) based on geographic location and historical usage



HTRW DQOs (Cont'd)

5) **Analytic Approach**
   - Delineate metals and PAH concentrations in surface and subsurface soil using incremental sampling methodology (ISM)
   - Background concentrations for metals and PAHs from background study area
   - Collect additional data to conduct human health and ecological risk assessments as needed

6) **Performance/Acceptance Criteria**
   - RI follows CERCLA
   - Screening analytical results to latest EPA RSLs

7) **Develop Plan for Obtaining Data**
   - Approval of UFP-QAPP

Proposed HTRW RI Approach

- General (Phased) approach for execution of data collection:
  - ***Phase I:***
    - ISM for sampling surface and subsurface soil sampling,
    - Perched groundwater sampling
  - ***Phase II***:
    - Additional environmental media will be targeted and sampled as needed to clearly define COPC migration routes and determine the full extent of impacts.

Proposed HTRW RI Phase I

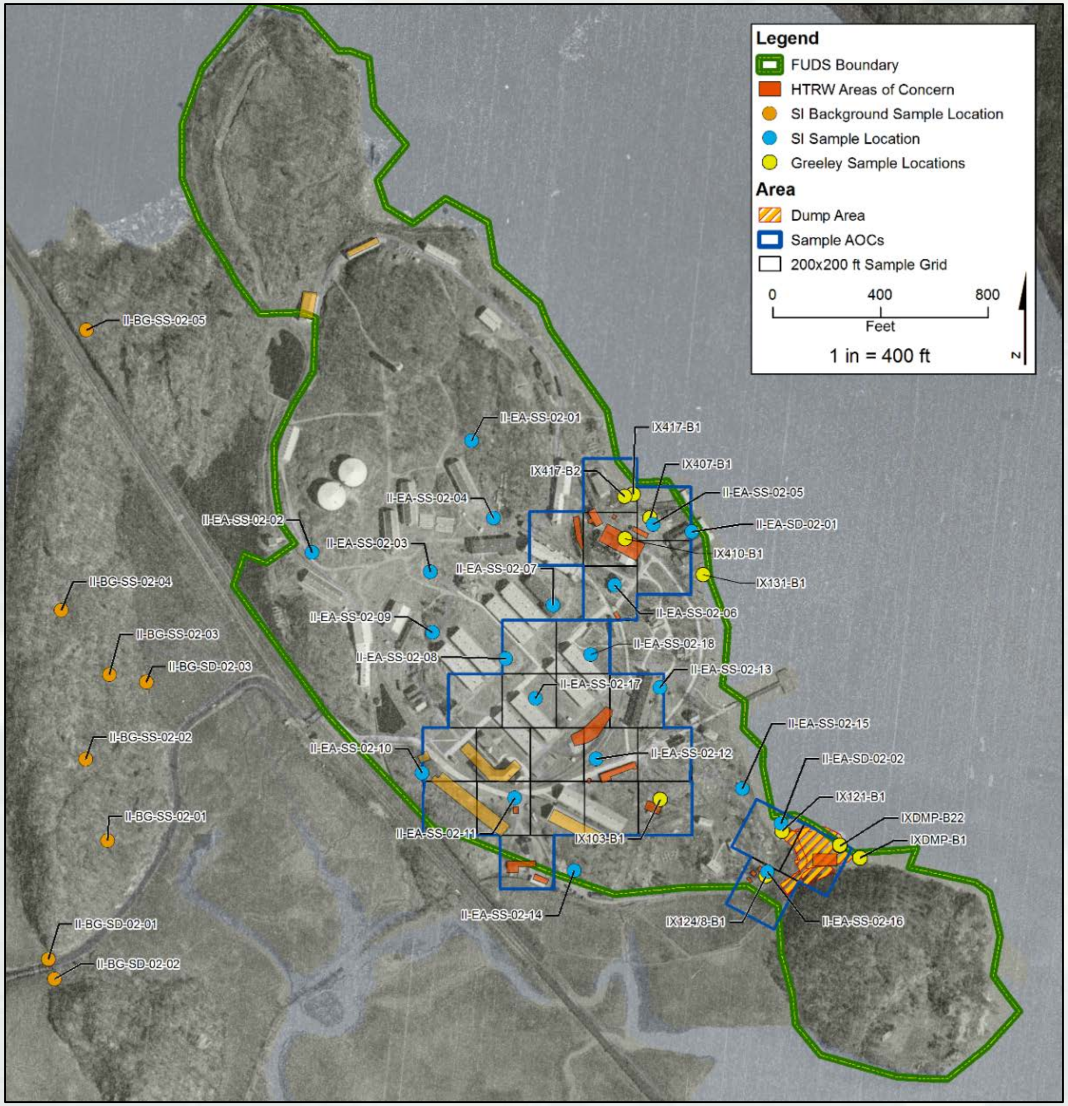
- ISM for surface and subsurface soil using 200x200-ft sample units (approximately 1 acre area) across 3 AOC investigation areas, additional background area

- 50 aliquots per sample unit
  - Surface soil 0-12”

  - Subsurface below 12”

- Grab sampling of perched groundwater in each AOC – 2 in northern AOC, 4 in Central AOC, and 2 in southern AOC

Proposed HTRW RI Phase I Approach (Cont'd)



Proposed HTRW RI Phase I Data Evaluation

- If COPCs exceed background concentrations for soil and EPA RSLs for soil or groundwater, a Baseline HHRA and SLERA will be conducted according to USEPA and USACE guidance for those COPCs
- Prepare Phase I Data Summary Report to present results
- Determine if additional data collection is needed (Phase II)
- Areas may be identified for “off-ramping”
- Only those contaminants identified as COCs will be carried forward to the FS

Potential HTRW RI Phase II Approach

- Phase II sampling to further refine nature and extent and exposure routes of COPCs:
  - Groundwater background sampling
  - Bedrock groundwater collection and analysis
  - Sediment sampling, sediment toxicity studies, ecotoxicity
  - Porewater collection and analysis
  - Benthic community analysis
  - Tissue collection and analysis

Path Forward

- Upcoming documents for review and comment:
  - TPP Memorandum
    - ✓ Summarize today's meeting
    - ✓ Identify action items and assign to team
  - UFP-QAPP
    - ✓ Summarize the RI Approaches
    - ✓ UFP-QAPPs will be submitted (March 2019) to stakeholders as Draft Final for review and comment

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Iona Island Formerly Used Defense Site
Military Munitions Response Program and Installation Restoration Program
Remedial Investigation through Decision Document
Technical Project Planning Meeting TPP #1
Meeting Memorandum
7 November 2018 0800 EDT

Meeting Attendees

Name of Attendee	Organization	Title
Todd Beckwith	CENAB	Technical Support
David King	CENAB	Geophysicist
Erin Kirby	CENAE	Project Manager
Cheryl Montgomery	CENAE	Risk Assessor
Rosemary Schmidt	CENAE	Geologist
Steven Scharf	NYSDEC	Project Manager
Edwin McGowan	PIPC/Parks	Science Director
Mike Tambroni	EA	Deputy Project Manager
Bob Casey	EA	Senior Scientist
Mike McGuire	EA*	Geophysics Program Lead
Dan Hinckley	EA*	Chemist
Melissa Beauchemin	EA	Risk Assessor
Nicole Wagner	EA	Scientist
Amanda Kohn	EA	Geologist
John Breznick	ANJV*	Geophysicist

Notes: * Indicates participation by teleconference.
ANJV = Acorn SI/NAEVA Joint Venture
CENAB = United States Army Corps of Engineers – Baltimore District
CENAE = United States Army Corps of Engineers – New England District
EA = EA Engineering, P.C. and Its Affiliate EA Science and Technology
NYSDEC = New York State Department of Environmental Conservation
PIPC = Palisades Interstate Park Commission

Meeting Minutes

Agenda Items	Meeting Minutes
• Introductions, CENAB, CENAE, PIPC/Parks, NYSDEC, and EA	- Following introductions by participants, Mike Tambroni (EA Deputy Project Manager) facilitated the Technical Project Planning (TPP) Meeting #1. General notes / minutes are below.
• TPP Purpose, presented by Mike Tambroni	- Purpose of the meeting is to present the technical approach from a high-level view and get feedback from stakeholders. - TPP is a four-phase process developed by the United States Army Corps of Engineers (USACE). The meeting will cover Phase 1 (Identify the project), Phase II (Determine data needs), and Phase 3 (Develop data collection options). The final data collection program will be presented in the Work Plans, which will be in Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) format. - EA will provide NYSDEC with a crosswalk of the UFP-QAPP.
• CERCLA Process, presented by Mike Tambroni	- The project follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The contract scope includes Remedial Investigation (RI) through Decision Document (DD). We are currently in the RI Phase. - Planning and investigative work during the RI phase will consider alternatives that may be included in the Feasibility Study (FS).
• Scope and Objectives, presented by Mike Tambroni (EA)	- The purpose of the project is to achieve DDs at the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS) for one Munitions Response Site (MRS), MRS-01 1903 Explosion and 16 Hazardous, Toxic, and Radioactive Waste (HTRW) Areas of Concern (AOCs).

Meeting Minutes

Agenda Items	Meeting Minutes
• **Scope and Objectives (continued)**, presented by Mike Tambroni (EA)	- Aboveground storage tanks (ASTs) and underground storage tanks (USTs) have been closed out under the Containerized HTRW (CON-HTRW) Program and will not be included as part of this investigation. - Separate UFP-QAPPs and two RIs will be completed for the project for the Military Munitions Response Program (MMRP) and the HTRW AOCs. - Mr. Scharf (NYSDEC) asked about radioactive waste. Mr. Tambroni (EA) noted there is no record of radioactive waste use at the site.
• **Site Location and Background, Site History**, presented by Mike Tambroni (EA)	- Iona Island is located in Stony Point, New York (NY) (south of West Point and north of Manhattan) and is maintained by Bear Mountain State Park. - Formerly used by the Navy between 1900 and 1947 as a Naval Ammunition Depot. - Aerial photograph on slide 7 looking north over island shows ammunition depot buildings, main dock. Majority of buildings were demolished. Mr. McGowan (PIPC) provided information about the current site conditions - some building slabs remain at Iona Island, and a bulkhead is still present on the shoreline. - The Navy used the site for preparing, assembling, maintaining, inspecting, and testing of ammunition; and storage of bulk explosives, ammunition, and ordnance material.
• **Physical Environment, Site Use and Potential Receptors**, presented by Mike Tambroni (EA)	- Land, wetland, and river environments. - Shallow soil, potential perched groundwater over bedrock. - Hudson River is tidally influenced, approximately 3.5 feet (ft). - Aerial photograph on slide 9 from early 2000s shows view looking west over Iona Island prior to marsh restoration. - Mr. McGowan (PIPC) provided information on use of the Iona Island regarding potential human receptors. • Use is limited to educational outings, history tours (6-8 times per year with approximately 50 people). The Island was used by the Boy Scouts for camping in the past. No longer used by the Scouts as the Island is not regularly patrolled by the Park Service, and there are physical hazards (not related to munitions or contaminants of potential concern [COPCs]). Park staff use the Island for storage. • Canoeing is by permit only. • There is no intent to put in a trail system. • Construction worker receptors are limited. There are no anticipated construction plans beyond potentially converting existing buildings for other use or constructing new storehouse. • There have been plans in the past to develop part of the island as a retreat/nature center, and a sewer system was even installed, but never used. • A developer has recently proposed plans for constructing an environmental center/nature center, however these plans have not been approved and are very preliminary. • Future use not anticipated to change from current use. • There are no deed restrictions currently on the property.

Iona Island Formerly Used Defense Site
Military Munitions Response Program and Installation Restoration Program
Remedial Investigation through Decision Document
Technical Project Planning Meeting TPP #1
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Meeting Minutes

Agenda Items	Meeting Minutes
• Physical Environment, Site Use and Potential Receptors (continued), presented by Mike Tambroni (EA)	- Majority of Island is open space. Seasonal closure in December through March for bald eagle use. Eagles primarily use the Island during the coldest winter months, and typically stay on the east side of the island. - Iona Marsh is part of National Estuarine Research Reserve - A busy freight rail line is located immediately east of the Island along the point of access. - Assume potential for continued recreational use in the future –while there were plans for development at one time, there are no anticipated plans for development on the horizon. It is unlikely that Iona Island would be treated like other parks due to accessibility and conditions of the site. - It is possible that buildings in disrepair could be demolished or existing footprints of buildings could be repurposed. There is no plan for utility work. - The existing storehouse has a defunct water supply/waterline that was put in to connect to a reservoir in Doodletown, but this was never hooked up. - The existing storehouse may have a working well that could be sampled as part of RI. There is a small staff in the storage house. Water is not potable – it is connected to an outdoor tap/faucet. - .
• MMRP sites discussion/overview, presented by Mike Tambroni (EA)	- Various munitions-related items were found in the past at the MRS as result of historic use of the site for military munitions. Ammunition was not manufactured at Iona Island. Activities included loading, filling/assembling, and storing munitions, including 13-inch shells. Chemical composition for the ordnance items of interest will be reviewed and a MC list will be developed and included in the MEC QAPP. Analytical suite will be selected based on munitions and explosives of concern (MEC) identified. - Three areas of interest have been identified for MEC investigation including: 1903 area, former loading docks and downstream shoreline, and dump area between Iona Island and Round Island. - Available information on the types and conditions of MEC is limited. A grenade was found in mid-1980s near buildings 311 and 314, however there is no information on whether the grenade was a practice or contained high explosives. A portion of 3.75-inch rocket warhead (tip of rocket) has also been recovered. - There is no indication of discarded military munitions (DMM) on land. In past during low water, ordnance items were reported along the eastern shoreline. Ordnance was not observed during the site walk. - Mr. McGowan (PIPC) stated that there are empty, large ordnance shells in storage – shells were X-rayed and confirmed to be practice (empty/inert). - It is unlikely that munitions would have been buried on land. Overburden at Iona Island is shallow. Main concern for DMM is the dump area and Hudson River. Historical records indicate that common practice by the Navy was to dispose of excess munitions out at sea.

Meeting Minutes

Agenda Items	Meeting Minutes
• 1903 Explosion Area RI approach, presented by Mike Tambroni (EA)	- Munitions constituents (MC) sampling will be conducted if a breached munition item is found. MC analysis will include a tailored list of MC metals and explosives specific to the ordnance item identified. - 1903 Explosion Area will be investigated using random Digital Geophysical Mapping (DGM) grid and Cued Advanced Geophysical Classification (AGC). The approximately 124.2-acre explosion area radius was provided by USACE. DGM will be conducted in 100x100ft grids. Vegetation would have to be cut to a maximum of 4 inches in each grid. There will be no cutting of existing trees. - Mr. McGowan (PIPC) stated that there are plant stands in the marsh and asked about moving grids if needed to avoid the stands. Restoration work has been conducted since 2008. EA can move locations as needed. There are surface elevation measuring points used to measure sedimentation rates; Mr. McGowan will provide the locations, however he believes they are just outside the explosion area. The entire marsh has been cut/mowed/mulched in the past, with multiple tracks/directions. Paths are currently mowed for access. - Mr. McGowan (PIPC) stated that protected migratory birds arrive and nest in April and fledge in July on Iona Island. Mike Tambroni (EA) stated that EA is targeting fall/winter for the investigative work when vegetation is down and water is lower. - Former building foundations/slabs may be visible with DGM, as such grids will not be located near these features. - Mr. McGowan (PIPC) stated that there is a memorial grove of small trees and, he will pull together a map showing the location. - Access to the marsh on the southwestern portion of the site near the railroad will be through a gate and along the railroad shoulder. EA will need to gain access from CSX (railroad), who will likely require a CSX employee to be onsite during investigation activities in this area. - If marsh conditions do not allow for the DGM, the alternative method will include mag and dig in this area. EA would work around tides.
• Dump Area RI approach, presented by Mike Tambroni (EA)	- DGM will be conducted in tightly spaced transects in the Dump Area. - Three areas were presented and included the Dump Area, non-DoD fill area, and 1940s shoreline fill area for fire line right-of-way and sewer discharge pipe. - Discussion ensued regarding investigation of the non-DoD, post-1960s fill area in the southern marsh adjacent to the southeastern side of Iona Island. Mr. Scharf (NYSDEC) suggested conducting test pitting in this area. His rationale is that there may be rubble from former Iona Island buildings overlying kickout MEC from the 1903 explosion. The explosion area radius expands over this area. The area is within the confines of the site, however construction debris was not moved/put there by DoD. USACE will check on the responsible party and funding for investigation. The area is likely not eligible for funding under the FUDS Program. Also, the investigation using grid squares distributed across the radius of the explosion area will provide a statistically-valid and meaningful evaluation of the blast area even if there is not a grid located specifically within the footprint of the post-DoD fill area. There is no record of filling in this area

Meeting Minutes

Agenda Items	Meeting Minutes
	prior to 1965. The area is a former wetland filled with loose material, and contains voids within/below debris. - 1940s fill area may be a potential HTRW site.
• **Former docks and shoreline RI approach**, presented by Mike Tambroni (EA)	- Docks will be investigated using underwater mag and dig. Shoreline will be investigated digital geophysical mapping (DGM). - While the primary flow direction of the Hudson River is south, tides could result in northward flow. USACE suggested expanding the shoreline investigation area north of the docks. In addition, USACE suggested expanding DGM downstream around Round Island.
• **Visual Sampling Plan**, presented by Mike McGuire (EA)	- Overview of the use of a Visual Sampling Plan (VSP) to determine the number and size of grids that will be used to investigate the 1903 Explosion. VSP is a module to statistically evaluate areas for the amount of potential munitions/MEC. Iona Island is not a high public land use area because the site does not include beaches, schools, or residential areas. Program inputs included MEC density input of 0.5 MEC per acre, 95% confidence level, and overall size of 1903 explosion area (124.2 acres). Output of VSP: investigate 6 acres, dig targets, and estimate potential MEC density. 100x100-ft grid is approximately 0.5 acres. Distributed grids throughout the 1903 explosion area to statistically evaluate the site. Grids are random but biased (avoiding tops of buildings, bedrock outcrops). Data will be collected (i.e., intrusively investigate selected targets) and a post-investigation analysis will be conducted to evaluate munitions density.
• **HTRW background**, presented by Bob Casey (EA)	- USACE obtained a right of entry permit from PIPC for conducting work on Iona Island. - USACE will need to contact CSX to pursue access from the railroad. - 16 HTRW AOCs with operational use and activities conducted by Navy are being investigated under this RI. Underground storage tanks (USTs) and above ground storage tanks (ASTs) are covered under containerized HTRW (con-HTRW). USTs were not truly underground – tanks put in place and bermed/buried. Former gasoline/diesel USTs/ASTs have been removed, geophysics investigations have been conducted at potential former UST locations. No additional USTs identified. NYSDEC will check database for closure documents. - Previous environmental investigations at Iona Island detected metals and semi-volatile organic compounds (SVOCs) in soil. EA is still developing the complete list of COPCs. Mr. Scharf (NYSDEC) asked about solvent use. There are no records or documentation of use. Based on overall conceptual site model (CSM), chlorinated volatile organic compounds (VOCs) would not be present. Last use would have been over 70 years ago. Physical environment is not conducive to long-term persistence – shallow soil over bedrock, tidal influence. Furthermore, AST and UST programs have been closed under con-HTRW so petroleum VOCs will not be pursued.

Meeting Minutes

Agenda Items	Meeting Minutes
• **CERCLA discussion**, presented by Bob Casey (EA)	- The HTRW RI is being conducted in accordance with CERCLA. The Army is the lead agency under the Defense Environmental Restoration Program (DERP), and DERP follows CERCLA per executive order. During the RI analytical results will be compared to screening criteria, and a human health risk assessment (HHRA) and screening level ecological risk assessment (SLERA) will be conducted. Under the FS, additional applicable or relevant and appropriate requirements (ARARs) such as state standards will be included to assess remedial action alternatives/goals. - Mr. Scharf (NYSDEC) asked about NYSDEC screening criteria. NYSDEC part 375 criteria is risk based. The RIs follow CERCLA and use a risk-based calculation, not a pass/fail of criteria. Mr. Scharf will run the approach past the health department. • USACE stated that this decision is programmatic. HHRA unacceptable risk is defined as an incremental cancer risk of greater than 10^{-4} and/or a hazard quotient greater than 1. Risk is managed between 10^{-4} and 10^{-6}. RIs will include site-specific risk assessments, which include a calculation of risk. Remediation will not be based on screening criteria, but rather the site-specific risk assessment which looks at exposure based on use.
• **Previous investigations and potential data gaps**, presented by Bob Casey (EA)	- Overview of previous investigations. Analytical data were compared to NYSDEC criteria. USACE suggested comparing previous data to EPA screening criteria to determine COPCs. EA will incorporate both EPA and NYSDEC screening values. The lowest value will be used to set Project Action Limits and to initially screen the data for the risk assessments. - Need to define background concentrations. Look at areas close to the site but not under influence of the site or other industrial activities. Locations need to be relevant to the study area for comparison. USACE stated that background locations in previous studies were too close to the site. Mr. Scharf (NYSDEC) suggested background locations in Bear Mountain State Park.
• **HTRW Data Quality Objectives discussion**, presented by Bob Casey (EA)	- Overview of HTRW contaminations and RI goals. 16 AOCs were grouped into three larger AOC groupings to determine area for investigation. Dr. Montgomery (CENAE) asked how AOC groupings were developed. Mr. Casey (EA) stated groupings were based on geographic location and historical Site Investigation (SI) data, including surface soil lead concentrations. A discussion of the previous proposed approach with discrete sampling ensued. Original intent was to bound high concentration soil areas. Elevated lead concentrations were reported in soil during the SI. Some of the higher lead detections were near the solder reclamation facility and incinerator. Lead was also likely related to lead-based paint. Soil has been considerably re-worked and re-distributed across the site during building demolition, which contributed to wide-spread, sporadic detections of lead in soil. Initial screening of analytical data was based on NYSDEC soil cleanup objective of 450 milligrams per kilogram (mg/kg). Areas with high concentrations above 450 mg/kg were targeted for further investigation. Detections of COPCs

Meeting Minutes

Agenda Items	Meeting Minutes
	outside the three AOC groupings were low. EA will re-screen previous results to develop a COPC list based on previous activities, site features (such as the incinerator and landfill) and focus on FUDs-related activities and related contaminants, and add this information to the rationale for the drawing of the AOC groupings.
• **Proposed HTRW RI discussion**, presented by Bob Casey (EA)	- RI will be conducted in two phases. Phase I will include surface and subsurface soil sampling using incremental sampling methodology (ISM). Results will be presented in a data summary report. Phase II will include additional sampling as needed. - Dr. Montgomery (CENAE) asked why sediment sampling was not being conducted. Mr. Casey (EA) stated that they would only investigate sediment if warranted per the Center of Expertise (CX) request. The Hudson River is a contaminated waterway with a history of impacts and potential to impact Iona Island and the shoreline. A discussion of sediment sampling and pros/cons ensued. Dr. Montgomery requested sediment sampling in key areas as it is uncommon not to sample sediment, especially at an island site. It was stated that it would be difficult to evaluate whether impacts are from DoD activities or an upstream source. Dr. Montgomery requested adding additional information in the UFP-QAPP detailing whether or not sediment sampling would be conducted and the rationale behind the decision. If the Hudson River depth/bathymetry and flow rates would not support a sustainable benthic habitat, then sediment sampling along the River could be eliminated. Alternatively, if the CSM indicates a need for sediment sampling based on data collected during Phase I and/or if MC/MEC is identified along the shoreline, sediment sampling in the River could be conducted during Phase II. - A discussion of groundwater sampling was conducted. Perched overburden groundwater sampling is proposed in Phase I, with perched defined as sustained flow. Bedrock sampling would be conducted in Phase II. The existing storage house well could also be included in the groundwater investigation. - Mr. Scharf (NYSDEC) said he would like to see where groundwater discharges to surface water. Ms. Schmidt (USACE) agreed that the site will need to be put in geologic context. Although there may be radial groundwater flow locally on the island, this may be overwhelmed by groundwater flow from the adjacent hillside (large recharge area) discharging to the river. - Site-specific geology/hydrogeology information will be further detailed in the UFP-QAPP.
• **ISM approach**, presented by Dan Hinckley (EA)	- Prior discussions occurred among USACE and EA that related to sampling design and whether discrete or incremental soil methodology (ISM) was most appropriate. USACE CX recommended using ISM for surface soil based on the munitions-related constituents and wide-spread detections. ISM is a statistical-based approach that is the most efficient and cost-effective way to obtain the largest quantity of surficial soil data across a large site.

Meeting Minutes

Agenda Items	Meeting Minutes
	- The ISM concept is to take an area/decision unit, grab aliquots, and composite aliquots for sampling. 200x200-ft decision units (DUs) (approximately 1 acre) were selected for Iona Island. - Surface soil sampling plan is to collect 50 aliquots across each DU at 0-6" depth, producing a sample approximately 1 to 2 kilograms in size for each DU. The samples would be sent to the lab for processing, which involves drying, sieving, and grinding. The concept is to homogenize soil associated with each DU, with analytical results providing concentration of chemicals for each DU. Decisions could be made for each DU depending on receptors – exposure could be calculated using results from individual DUs or a combined number of DUs – calculate mean exposure across an area. - Subsurface soil sampling plan is to advance 5 borings per DU, take 10 aliquots from cores up to 4 feet or until groundwater or bedrock is reached. A total of 50 subsurface aliquots would be collected for each DU. - DUs are approximately 1 acre in size based on the primary receptors (park employees, occasional recreational users, possible construction workers). - Surface soil would be collected using hand augers or similar tool. - Subsurface soil would be collected using a Geoprobe, with borings advanced to bedrock. It was noted that track or truck-mounted Geoprobes are available. The investigation area does not extend into the marsh.
• Phase I data evaluation, discussion presented by Bob Casey (EA)	- Interim data report will include screening and risk assessment. TPP meeting will be conducted to discuss data. Phase II investigation will be further defined following Phase I Report/TPP.
• Path forward discussion, presented by Bob Casey (EA)	- TPP Memorandum will be prepared following this TPP meeting to review and summarize action items. - UFP-QAPPs will be submitted to stakeholders (NYSDEC, PCIP) in Draft Final form in 2019, anticipating March 2019. - E-QAPP discussion – data will be managed in FUDs Online Chemical Database (FUDSCHEM), which is a storage system for USACE. It is important that E-QAPP be 100% correct. NYSDEC requested electronic data (EQUIS/Earth soft).
• Additional discussion	- Mr. McGowan (PIPC) mentioned the Hudson River Research Project – DOT is conducting wetland mitigation. Parks department supplied 3 sites on Iona Island to use as potential banking area. Potentially using a parking lot area on the north end of the Island. - Mr. Beckwith (USACE) mentioned a potential MMRP issue with bulk explosives at former buildings. Explosives could have washed into building foundation cracks, sumps, utility pipes through floor drains, drywells, sumps, cracks, etc. Requests evaluation of accumulation of bulk explosives, which could be an explosive safety issue. Could also be an MC issue. Could locate former slabs and infrastructure on maps or with geophysics. This effort is not a part of the current funded investigation.

Action Items

Responsibility	Action Item
EA	• Send historical documents to stakeholders. • Conduct National Heritage consult with the New York Park Service. • Re-evaluate previous data and historical site use/activities to define COPC list and support AOC groupings.
CENAE/CENAB	• Check on appropriate funding stream for non-DoD Fill Area for potential future investigation. • Follow up on potential MMRP issue with bulk explosives at former buildings which could be an explosive safety issue and/or MC issue. This was not in the original scope. • Coordinate with CSX to obtain access agreement
NYSDEC	• Check database for UST/AST closure documents.
PIPC	• Confirm no future development plans with the Executive Director. • Provide a map of the location of the memorial grove of trees. • Provide map with locations of potential wetland reclamation areas.

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Appendix B

Accident Prevention Plan
(Includes Site Specific Health and Safety Plan and Dive Operations Work Plan)

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REVISION 1
ACCIDENT PREVENTION PLAN

MILITARY MUNITIONS RESPONSE PROGRAM AND HAZARDOUS TOXIC AND RADIOACTIVE WASTE SITES REMEDIAL INVESTIGATION THROUGH DECISION DOCUMENT AT THE IONA ISLAND NAVAL AMMUNITION DEPOT FORMERLY USED DEFENSE SITE, ROCKLAND COUNTY, NEW YORK

PREPARED BY:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

MAY 2019

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Revision Tracking

Date	Revision	Description and Sections Affected
12/2018	0	Baseline document
5/20/2019	1	Response to comments Text edits Appendix G Appendix H

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF ACRONYMS AND ABBREVIATIONS

ABIH	American Board of Industrial Hygiene
ACGIH	American Conference of Governmental Industrial Hygienists
AED	Automatic external defibrillator
AEODS	American Explosive Ordnance Disposal Services
AGC	Advanced geophysical classification
AHA	Activity hazard analysis
ANJV	Acorn SI/NAEVA Joint Venture
AOC	Area of Concern
AOR	AOR International, LLC
APP	Accident prevention plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COR	Contracting Officer's Representative
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
CON/HTRW	Containerized Hazardous Toxic and Radioactive Waste
DAGCAP	Department of Defense Advanced Geophysical Classification Accreditation Program
dBA	Decibel(s)
DD	Decision document
DDESB	Department of Defense Explosives Safety Board
DGM	Digital geophysical mapping
DMM	Discarded military munitions
DPIC	Direct Person in Charge
DU	Decision Unit
EA	EA Engineering, Science, and Technology, Inc., PBC
EM	Engineering manual
ft	Foot (feet)
FUDS	Formerly Used Defense Site
GPS	Global Positioning System
GFCI	Ground fault circuit interrupter
HAZWOPER	Hazardous Waste Operations and Emergency Response
HTRW	Hazardous Toxic and Radioactive Waste
IDW	Investigation-derived wastes
in.	Inch(es)

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

KO	Contracting Officer
LEP	Licensed Environmental Professional
MD	Munitions debris
MDAS	Material documented as safe
MEC	Munitions and explosives of concern
MMRP	Military Munition Response Program
MPPEH	Munitions potentially presenting an explosive hazard
MR	Munitions response
MRS	Munition response site
NYSDEC	New York State Department of Environmental Conservation
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
P.E.	Professional Engineer
P.G.	Professional Geologist
PhD	Doctor of Philosophy
PIPC	Palisades Interstate Park Commission
PMP	Project Management Professional
PPE	Personal protective equipment
PWS	Performance Work Statement
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
QCS	Quality control specialist
RAC	Risk assessment code
RI	Remedial investigation
RTK	Real-time kinematic
SDS	Safety data sheet
SHM	Safety and Health Manager
SSHO	Site Safety and Health Officer
SSHP	Site safety and health plan
STR	Senior technical review
SUXOS	Senior Unexploded Ordnance Supervisor

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

TBD	To be determined
TOI	Target(s) of interest
TLV	Threshold limit value
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S Environmental Protection Agency
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

1. INTRODUCTION

This Accident Prevention Plan (APP) has been prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) to support the Military Munition Response Program (MMRP) and Hazardous Toxic and Radioactive Waste (HTRW) Remedial Investigation (RI) through Decision Document (DD) for the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS), Rockland County, New York (**Figure 1-1**). The scope of the project includes conducting an RI through DD at MMRP Munitions Response Site (MRS)-01 1903 Explosion Area and at 19 HTRW Areas of Concern (AOCs) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Work conducted under this contract will be performed in accordance with applicable federal, state, and local safety and occupational health laws and regulations including: Occupational Safety and Health Administration (OSHA) Standards (including 29 Code of Federal Regulations [CFR] 1910 and 1926), the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (Engineering Manual [EM] 385-1-1, 30 November 2014), and USACE EM 385-1-97. The contents of this APP are subject to review and revision as new or additional information becomes available.

1.1 SIGNATURE SHEET

Plan Preparer

This APP has been prepared by Qualified Persons.

Denise Wilt

20 May 2019

Name:	Denise Wilt, Professional Geologist (P.G.)		Date
Title:	Senior Geologist		
Company:	EA	Telephone: 410-584-7000	

Plan Approvals

An officer of the company with the authority to obligate the company has approved this APP.

Gordon Porter

20 May 2019

Name:	Gordon Porter		Date
Title:	Vice President, Site Characterization and Remediation Business Unit Director		
Company:	EA	Telephone: 410-329-5113	

An American Board of Industrial Hygiene (ABIH) – Certified Industrial Hygienist (CIH) and a Certified Safety Professional (CSP) has supervised the preparation, reviewed, and approved this APP:

20 May 2019

Name: Peter Garger, CIH (ABIH No. 3118) Date:
CSP (Board of Certified Safety Professionals No. 20560)
Title: Director of Safety and Health/Safety and Health Manager (SHM)
Company: EA Telephone: 410-527-2425

Certification/Concurrence:

Project and Program Management has concurred with the elements of this APP. Site worker concurrence will be documented through signature on an APP/Site Safety and Health Plan (SSHP) review form.

Brenda Herman

20 May 2019

Name: Brenda Herman, P.G. Date
Title: Senior Vice President, Army Programs, Delivery Order Program Manager
Company: EA Telephone: 410-527-2474

20 May 2019

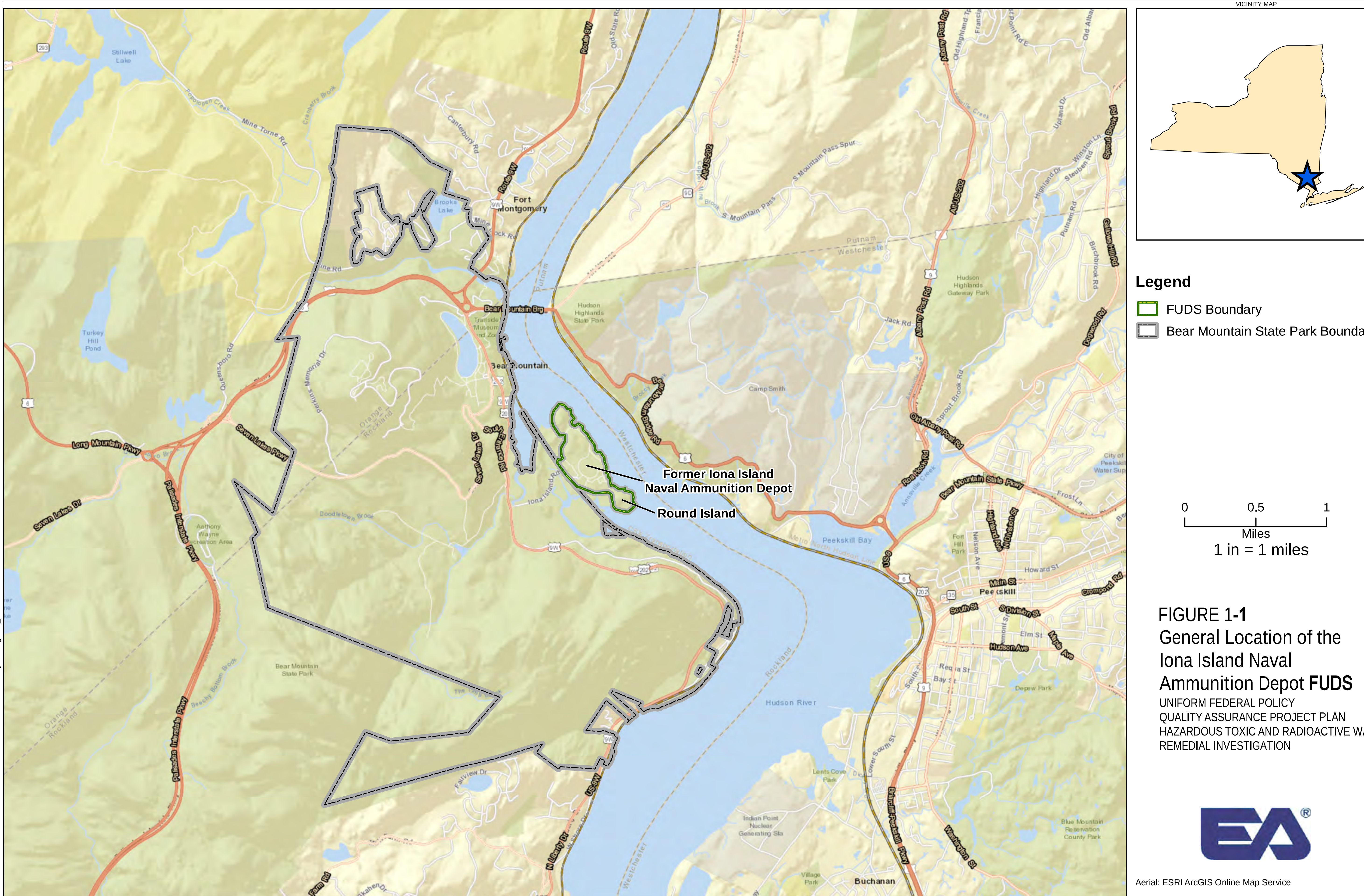
Name: Frank Barranco, Jr., Doctor of Philosophy (PhD) Date
Professional Engineer (P.E.), P.G.
Title: Director of Quality Control (QC)
Company: EA Telephone: 410-329-5137

20 May 2019

Name: Timothy Reese, P.E. Date
Title: Project Manager
Company: EA Telephone: 410-671-6051

1.2 REVISIONS

Changes in the Performance Work Statement (PWS), field changes, or unanticipated site conditions may require APP modification and approval in order to retain field safety. Changes will be made by the Plan Preparer with input from other qualified personnel familiar with the types of work involved and current site safety issues. The revisions and/or APP addenda will also be submitted to USACE–Baltimore District for acceptance.



Legend

- FUDS Boundary
- Bear Mountain State Park Boundary

0 0.5 1
Miles
1 in = 1 miles

N

FIGURE 1-**1**
General Location of the Iona Island Naval Ammunition Depot **FUDS**
UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN
HAZARDOUS TOXIC AND RADIOACTIVE WASTE
REMEDIAL INVESTIGATION

Aerial: ESRI ArcGIS Online Map Service

Map Date: 1/2/2019

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2. BACKGROUND INFORMATION

This section presents a brief description of the project including site description, PWS, and phases of work.

Contractor: EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle
Suite 400
Hunt Valley, Maryland 21031

Contract Number: W912DR-15-D-0014, Delivery Order W912DR18F0587

Project Name and Location: MMRP and HRTW RI through DD for Iona Island Naval Ammunition Depot FUDS, Rockland County, New York (**Figures 2-1** and **2-2** Areas of Investigation Maps)

2.1 PROJECT DESCRIPTION

USACE has contracted EA to conduct an RI through DD at the Iona Island Naval Ammunition Depot FUDS, located in Stony Point, Rockland County, New York. The Iona Island FUDS is a bedrock island located on the Hudson River and consists of approximately 125 acres of land and inland water. Previous investigations have resulted in the discovery of munitions and explosives of concern (MEC) and inorganic compounds that exceed regulatory screening levels in site soil and sediment. The FUDS property is within Bear Mountain State Park which is part of the much larger Hudson River National Estuarine Research Reserve, a Significant Coastal Fish and Wildlife Habitat Area and National Natural Landmark and is owned by the Palisades Interstate Park Commission (PIPC). PIPC currently utilizes a portion of Iona Island as a storage facility; however, the property is closed to the public and use is restricted to park purposes only.

USACE is conducting work at the site under the Defense Environmental Restoration Program for FUDs using the processes under the Comprehensive Environmental Response, Compensation, and Liability Act. The FUDS program cleans up only DoD-generated eligible contamination, which occurred before the transfer of the property to private owners or federal, state or local governments. There are three FUDS projects at the former Iona Island Naval Ammunition Depot FUDS:

- C02NY074401 Containerized Hazardous Toxic and Radioactive Waste (CON/HTRW)
- C02NY074402 HTRW
- C02NY074403 Military MMRP.

This APP addresses the FUDS MMRP and HTRW project categories. The FUDS CON/HTRW was closed out in 2012. The FUDS MMRP includes one Munitions Response Site (MRS), MRS-01 1903 Explosion area (approximately 124.2 acres of land and inland water. MRS-01 extends beyond the FUDS boundary (**Figure 2-1**). The FUDS HTRW includes and 19 AOCs located in the footprints of former site facilities where various contaminants of potential concern resulting from historical site activities have been detected or may be present (**Figure 2-2**).

A MMRP RI will be conducted at MRS–01 (referred to as the 1903 Explosion) area and an HTRW RI will be conducted at 19 AOCs. The MMRP RI will characterize the occurrence of MEC and the HTRW RI will characterize contaminants of potential concern including metals, volatile organic compounds, and semi-volatile organic compounds that may be present in soil and groundwater from facilities or historic processes during the site's commission as an ammunition depot. Areas to be investigated under the MMRP RI are shown on **Figure 2-1** and areas to be investigated under the HTRW RI are shown on **Figure 2-2**. Field work will consist of multiple site mobilizations for RI field activities.

2.2 PHASES OF WORK

Brief descriptions of each phase of work associated with the RI are presented below. Detailed descriptions of the work are presented in the Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) (EA 2018). All phases of anticipated work are presented below; however, only a subset of phases require an activity with a dedicated Activity Hazard Analysis (AHA). Task-specific required equipment is listed on each AHA. Risk Assessment Codes (RACs) for the AHAs required to complete the PWS do not indicate high risk activities are to be completed. The site-specific AHAs are listed in **Table 2-1** and AHAs are presented in **Appendix A**. **Figure 2-1** shows the general site location, site features, and areas to be investigated related to MMRP RI. **Figure 2-2** shows the general site location, site features, and areas to be investigated related to HTRW RI. The general scope of planned MMRP and HTRW RI field activities is detailed below:

- Land-based and water geophysical surveys for MEC.
- Anomaly reacquisition and intrusive investigation activities will be conducted at targets of interest (TOIs) following digital geophysical mapping (DGM)/ Advanced Geophysical Classification (AGC) acquisition and processing at Magnetometer and Dig (Mag and Dig) locations for MEC investigation.
- Underwater intrusive investigations utilizing divers, to characterize the underwater area immediately surrounding three former loading docks locations for MEC.
- Direct-push technology sampling of soil and installation of piezometers.
- Bedrock well installation using air rotary drilling, development, and sampling, if necessary.
- Collection of soil, groundwater, and sediment samples for laboratory analysis.
- Material potentially presenting an explosive hazard (MPPEH) removal and disposal will be completed.

- Manage investigation-derived wastes (IDW) including soil and water.

2.2.1 Site Mobilization/Demobilization

For the MMRP RI, mobilization/demobilization will occur three times based on the proposed field schedule– during DGM, AGC, and during Mag and Dig and intrusive activities. For the HTRW RI, mobilization/demobilization will occur two times based on the proposed field schedule to accommodate a phased approach to the investigation. Mobilization for each phase will include setting up an equipment storage space (as needed), receiving and setting up equipment, locating dock facilities for the marine-based investigation (MMRP RI), safety meetings, and mobilizing staff to the site. This phase of work includes the delineation of equipment laydown and MEC support areas. An instrument verification strip will be established (MMRP RI). All equipment will be removed from the site upon completion of work.

2.2.2 Land Survey

A New York-licensed professional land surveyor will establish control points within the survey area to establish site control prior to starting fieldwork. The EA Team will conduct additional surveying of grid corners, MEC locations, and other significant items/positions using a Trimble R8 (or equivalent) real-time kinematic (RTK) Global Positioning System (GPS), which has centimeter accuracy. MEC anomaly avoidance will be conducted in support of the surveying activities.

2.2.3 Brush Clearing

Some cutting of grasses, brush, or branches interfering with geophysical surveys and land surveying activities will be conducted with hand tools, powered hand weed eaters, and/or brush hog as needed. No trees greater than 2 inches (in.) in diameter will be cut down and cut vegetation will remain onsite. MEC anomaly avoidance will be conducted in support of the brush clearing activities.

2.2.4 MMRP RI Land-Based and Shallow Water Geophysical Surveys

Land-based and water geophysical surveys will be performed to characterize the nature and extent of MEC using DGM. These activities will include land surveying; grid stakeout; and surface clearance prior to data acquisition. Acorn SI/NAEVA Joint Venture (ANJV), a Department of Defense Advanced Geophysical Classification Accreditation Program (DAGCAP)-accredited geophysical classification organization, will provide land and water DGM and land-based advanced geophysical classification services. MEC anomaly avoidance will be conducted in support of the geophysical surveying activities.

2.2.4.1 DGM Surveys

An EM61-MK2/RTK-GPS DGM survey will be performed over 100 percent of the coverage grids in MRS-01 to detect and locate anomalies that are representative of potential MEC. The survey will be performed by the field crew moving geophysical equipment over the ground surface. The goal of the DGM survey is to detect and locate anomalies above the approved target selection criteria, identify potential background locations for the cued AGC survey, and determine areas where cued AGC might not be applicable or provide value. Grids will be randomly placed, and may vary in size (e.g., 50 feet [ft] by 50 ft in High Density Areas, and 200 ft by 200 ft in Low Density Areas) depending on Project Delivery Team input. DGM will be collected in grids by a 2-person team comprised of a Field Geophysicist and a Geophysical Technician using Geonics EM61-MK2 electromagnetic induction sensors. The EM61-MK2 1.0- x 0.5-meter coil will be used to collect the DGM data over accessible portions of each grid, and the data will be positioned with RTK-GPS. It is anticipated that DGM detection survey data will need to be collected along parallel lines spaced 2 ft apart but will be confirmed during the technical project planning process. DGM transects will also be collected along the Hudson River shoreline near the former docks, and within areas suspected of buried discarded military munitions (DMM) such as "dump sites" and munitions storage areas. Transect spacing is anticipated to be 10 ft and will use the same equipment, personnel, and procedures as the grid-based data collection.

2.2.4.2 AGC Surveys

Cued AGC survey using an advanced geophysical sensor (e.g., Geometrics MetalMapper 2x2) will be conducted following the DGM detection survey. The survey will be performed by the field crew moving geophysical equipment over the grounds surface. The cued survey will provide high quality data to support classification decisions and generate a prioritized TOI Dig List to correctly classify TOI and non-TOI and reduce the intrusive effort associated with the MMRP RI, as well as provide a basis for using AGC as a remedial alternative going forward.

2.2.5 MMRP RI Land Intrusive Investigations

AGC TOIs identified for investigation will be reacquired in advance of intrusive investigation using RTK-GPS. EA will excavate anomalies to positively identify the item and will maintain a detailed record of the items, including amounts of MEC; proper identification nomenclature; and condition, location, depth, and disposition. In areas identified during the DGM survey that could potentially represent a potential DMM disposal area, EA will perform test pitting along its sides using a backhoe to determine the nature of the buried material. Based on the depth to bedrock it is not anticipated that excavations will be deeper than two feet. If after investigating enough to determine that the material is not munitions related and the team can be confident the area is not a DMM disposal area, a determination that further excavation is unnecessary will be made. At locations where test pitting results indicate munitions-related items are present, the excavation will continue to depth of the fill material (e.g., undisturbed soil) to characterize the vertical extent of munitions disposal.

Each intrusive investigation excavation will remain open until final quality assurance (QA)/QC is performed by the unexploded ordnance (UXO) Quality Control Specialist (UXOQCS) and Ordnance and Explosives Safety Specialist (OESS) (if present). Once the excavation has passed QA/QC, the excavation will be backfilled, and the flag removed. If disposal by detonation is necessary, post-detonation sampling for explosive residues may be required prior to restoration.

In areas where DGM and cued AGC are not practical in MRS-01, including heavily vegetated areas and other terrain that represent unsafe operating conditions for the equipment, geophysical survey (and intrusive investigation) may be accomplished using handheld all-metal detectors (i.e., Mag and Dig).

The majority of anomalies will be hand excavated; a mini excavator will be used as needed.

2.2.6 MMRP RI Underwater Intrusive Investigations

The area surrounding the three former loading docks will be investigated using UXO-qualified divers. In the 3 to 60-ft water depth, the investigation of these areas will be conducted by a UXO qualified dive team (AOR International, LLC [AOR]) using surface-supplied air and equipped with hand-held detection instruments (an Underwater Ebinger 725K analog detector fitted with a 230 mm coil (or similar detector). The Hudson River current is estimated to be 1 to 2 knots during ebb-and-flow tides, and a safety concern that could impede the investigation. It is for this reason that the underwater investigation will only be conducted during times that are determined acceptable by the Direct Person in Charge (DPIC) of diving. For efficiency and safety, divers will be employed in areas where they will be most efficient (i.e., shallow areas with less current where water depth allows longer bottom times, during slack tide in deeper water). In shallow, near-shore 0- to 3-ft water depth, intrusive investigations around the docks will be performed by wading rather than diving. UXO-qualified divers will be wading in the shallow water to complete the investigation tasks. The wading will be accomplished by walking through the water and reaching down when there is a magnetic anomaly. If needed, the UXO-qualified divers will be using diving masks to improve visibility.

For both the shallow and deeper underwater intrusive investigations, the UXO dive team, will employ a Shark Marine Navigation Tablet navigation. Transects of each loading dock area will be pre-loaded into the Shark Marine Navigation Tablet prior to diving operations. The tablet will be connected to a global navigation satellite system (GNSS) buoy for locating and tracking divers along transects. The GNSS GPS will be tested daily to ensure the positioning systems are functioning as designed and within the planned parameters for the project. The GNSS GPS will confirm the known monument location. If the coordinates are within the GPS tolerance of less than 2m (GNSS GPS) the control monument will be considered as satisfactory. After entering the water, the diver can view the underwater transects on the Shark Marine Navigation Tablet and navigate towards the outer edge of the pre-planned investigation area, as needed to begin investigation activities. Planned routes will be displayed on the Shark Marine Navigation Tablet, in one color for the diver to follow while actual diver's routes are plotted in another color. Route plotting and contact information will be recorded and reviewed daily and provided to USACE. Positioning information (i.e., tracks) obtained through GNSS navigation will be recorded by the Shark Marine Tablet and will allow the diver to visually follow his transect. The geo-referenced digital path will undergo QC review for coverage.

2.2.7 MMRP RI Soil Sampling

No munitions constituent sampling is proposed based on the results of the site inspection; however, soil samples may be collected and analyzed for explosives where breached MEC are identified. Management of IDW including soil will be conducted as it is generated. MEC anomaly avoidance will be conducted in support of the soil sampling activities.

2.2.8 HTRW RI Direct Push and Piezometer Sampling

Surface and subsurface soil samples will be collected for analysis of metals and semivolatile organic compounds using incremental sampling methodology (ISM) within 26 decision units (DUs) covering the AOCs, and within and one offsite DU anticipated to be located in Bear Mountain State Park. Each DU will be approximately 1 acre in size, with 50 aliquot surface soil and 50 aliquot subsurface soil samples collected from each DU as follows:

- Surface soil samples will be collected from 0 to 6 in. below the vegetative cover
- Subsurface soil samples will be collected from 5 borings advanced in each DU. Borings will be advanced using direct-push methods (direct-push mechanical equipment) to bedrock or a maximum of 4 ft if bedrock is not encountered. A total of 10 aliquots will be collected per boring from the 6 in. to 48 in. depth interval.

In addition, soil at former above ground storage tank locations will be investigated for the presence of volatile organic compounds using discrete sampling methodology. Samples submitted for laboratory analysis will be field screened and selected based on field observations. Surface samples will be collected from 0 to 6 in. below the vegetative cover. At minimum, one subsurface soil sample will be collected from the 12 to 24 in. depth interval and one from the overburden/bedrock interface.

Groundwater samples will be collected from the overburden soil using piezometers installed within select subsurface boring locations using direct-push mechanical equipment. MEC avoidance procedures will be performed by UXO technicians during well installation activities. Management of IDW including soil and groundwater will be conducted as it is generated.

2.2.9 HTRW RI Bedrock Well Installation

Up to three bedrock monitoring wells will be installed if determined necessary. It is anticipated that they will be installed using air rotary drilling methods (air-rotary drilling equipment). Monitoring well development and sampling would follow U.S. Environmental Protection Agency (USEPA) low-flow guidelines. MEC avoidance procedures will be performed by UXO technicians during well installation activities. Management of IDW including rock cuttings and water will be conducted as it is generated. MEC anomaly avoidance will be conducted in support of the well installation activities.

2.2.10 HTRW RI Sediment Sampling

Sediment sampling will be completed at 6 discrete locations along the shore of Iona Island topographically downgradient from AOCs, and from and 5 discrete background locations upstream along the Hudson River (i.e. at or north of Bear Mountain Bridge). Sediment samples will be collected during periods of low tide at depths of from 0 to 4 in. Additional toxicity sediment sampling may be conducted as necessary. MEC avoidance procedures will be performed by UXO technicians during all sampling activities. MEC anomaly avoidance will be conducted in support of the sediment activities.

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Table 2-1 Phases of Work and Site-Specific Activity Hazard Analyses

Site-Specific Activity Hazard Analysis [a]	MMRP RI Tasks										HTRW RI Tasks					
	Mobilization and Demobilization	Land Survey	Brush Clearing	DGM Surveys	AGC Survey	Mag and Dig	Soil Sampling	Land-Based Intrusive Investigation	Underwater Surface and Investigation	Sediment Sampling	Mob. And Demobilization	Direct Push Soil Boring	Piezometer Installation	Ground-water Sampling	Sediment Sampling	Bedrock Well Installation
General	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Large Hand Tools Use	X		X													X
Small Hand Tools Use	X			X	X					X			X	X		X
Intrusive Investigation of Target Anomalies								X	X							
MEC Avoidance		X	X	X	X		X	X		X		X	X		X	X
MEC Detector-Aided Surface/Subsurface Clearance		X	X	X	X	X		X								
MPPEH Inspection			X	X	X	X		X	X							
MEC Disposal			X	X	X	X		X	X							
Munitions Debris Inspection and Disposition			X	X	X	X		X	X							
Soil Sampling							X	X								
Surface Water/Sediment Sampling										X					X	
Groundwater Sampling/Well Development														X		
Direct Push Soil Boring/ Well Installation												X				X
Boating Operations									X							
Diving*									X							

[a] Site-specific activity hazard analyses are presented in Appendix A.
* Included with the Dive Plan (Appendix H).

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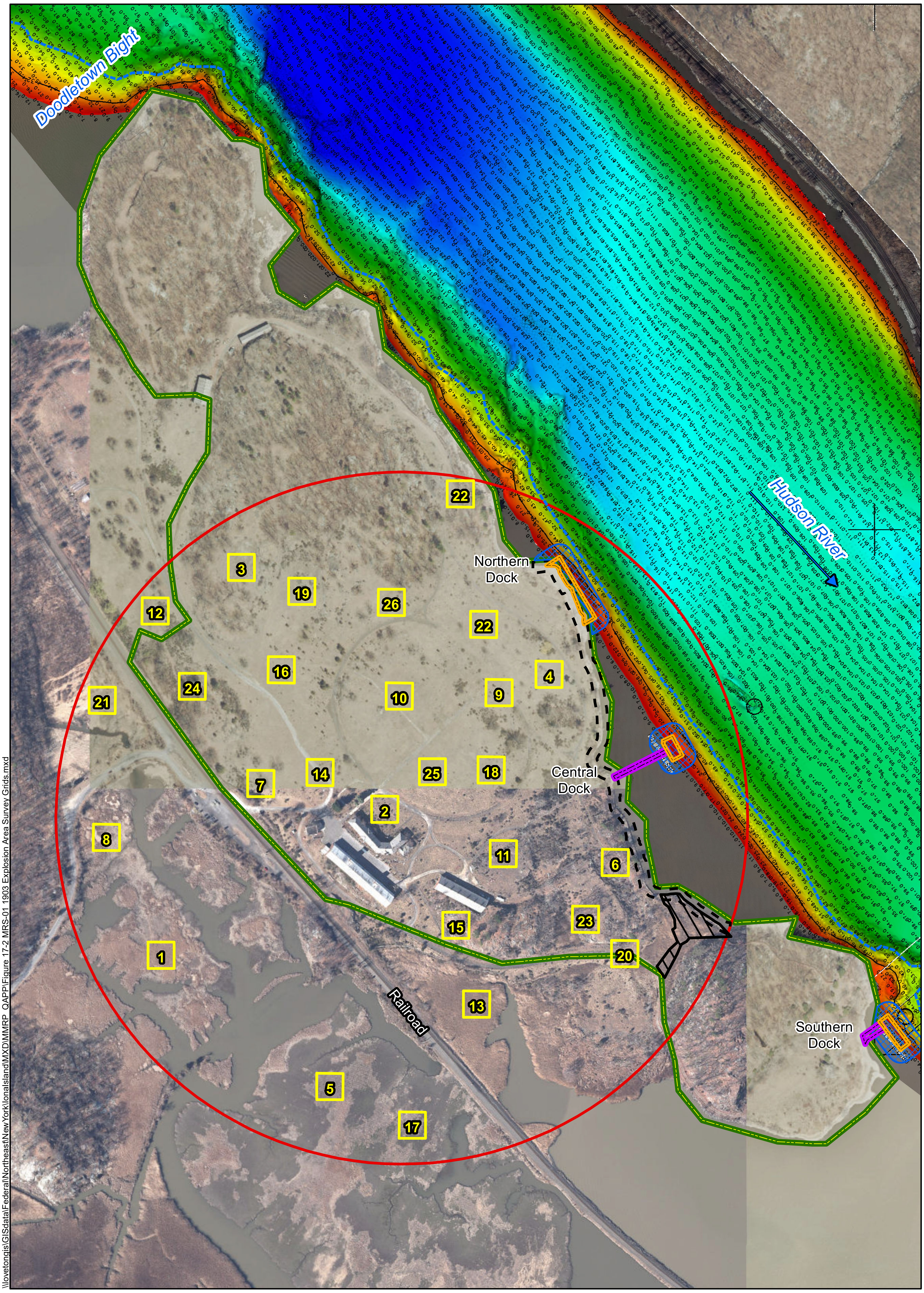

0 450 900
Feet

N

Legend

- Approximate 60 Foot Depth Line
- DGM Grid (100ft x 100ft)
- Underwater Investigation Area (Former Docks)
- DGM Shoreline Area
- Dump SIte
- Former Dock
- Former Causeway
- FUDS Boundary
- MRS-01 1903 Explosion Area

Note:
Dives will be limited to 3-60 ft or where the river bottom is less then 20 degree slope or determined acceptable by Direct Person in Charge.
Transects in water depth less then 3 ft will be walked.

FIGURE 2-1
MRS-01 1903 EXPLOSION AREA SURVEY GRIDS

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 11/22/2019
Dock Aerial - June 18 1948

\\lovetongis\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 17-2 MRS-01 1903 Explosion Area Survey Grids.mxd

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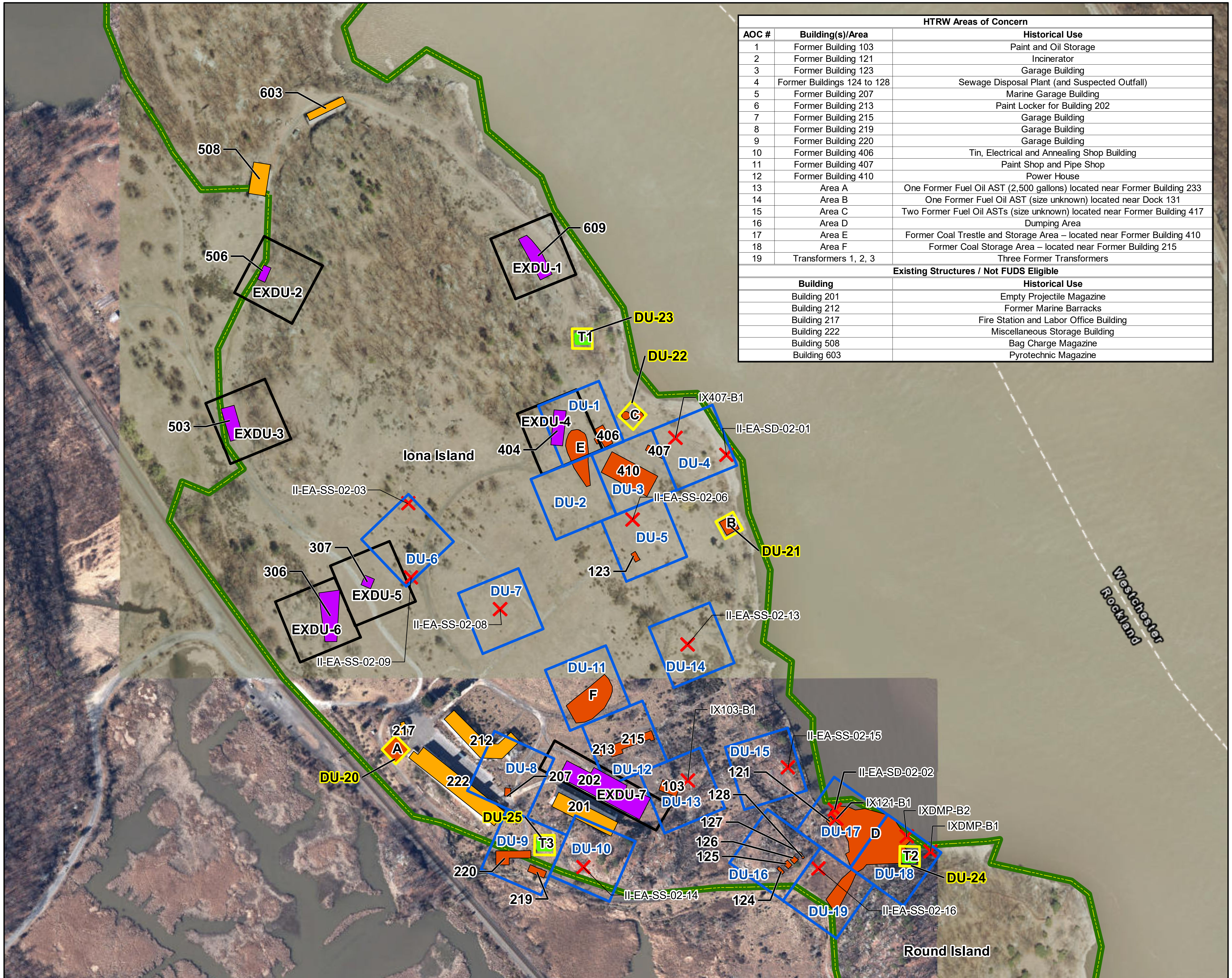
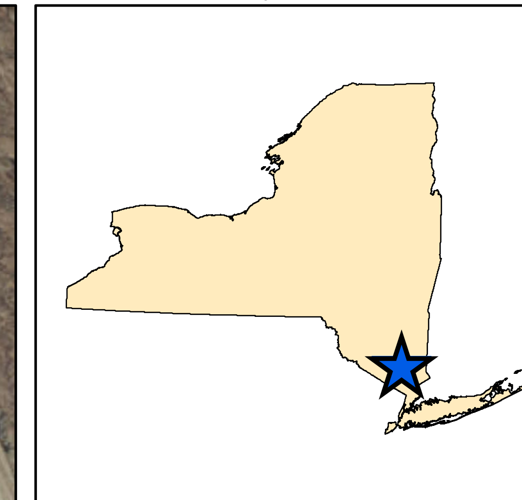


HTRW Areas of Concern		
AOC #	Building(s)/Area	Historical Use
1	Former Building 103	Paint and Oil Storage
2	Former Building 121	Incinerator
3	Former Building 123	Garage Building
4	Former Buildings 124 to 128	Sewage Disposal Plant (and Suspected Outfall)
5	Former Building 207	Marine Garage Building
6	Former Building 213	Paint Locker for Building 202
7	Former Building 215	Garage Building
8	Former Building 219	Garage Building
9	Former Building 220	Garage Building
10	Former Building 406	Tin, Electrical and Annealing Shop Building
11	Former Building 407	Paint Shop and Pipe Shop
12	Former Building 410	Power House
13	Area A	One Former Fuel Oil AST (2,500 gallons) located near Former Building 233
14	Area B	One Former Fuel Oil AST (size unknown) located near Dock 131
15	Area C	Two Former Fuel Oil ASTs (size unknown) located near Former Building 417
16	Area D	Dumping Area
17	Area E	Former Coal Trestle and Storage Area – located near Former Building 410
18	Area F	Former Coal Storage Area – located near Former Building 215
19	Transformers 1, 2, 3	Three Former Transformers

Existing Structures / Not FUDS Eligible	
Building	Historical Use
Building 201	Empty Projectile Magazine
Building 212	Former Marine Barracks
Building 217	Fire Station and Labor Office Building
Building 222	Miscellaneous Storage Building
Building 508	Bag Charge Magazine
Building 603	Pyrotechnic Magazine

VICINITY MAP



Legend

- FUDS Boundary
- HTRW Project Areas of Concern
- FormerTransformers
- Remaining Structure (Not FUDS Eligible)
- Previous Elevated Concentration of COPC
- 200 ft x 200 ft DU
- 60 ft x 60 ft DU
- Former Buildings with Significant Potential for Explosive Hazard (Included in the HTRW RI pending direction of contracting offer)
- 1 Acre Explosives Building DU

0 300 600
Feet
1 in = 300 ft

N

Aerial: ESRI ArcGIS Online Map Service

Map Date: 11/26/2019

FIGURE 2-2
HTRW Project AOC Incremental Sampling Decision Units

IONA ISLAND NAVAL AMMUNITION DEPOT
Formerly Used Defense Site
ROCKLAND COUNTY, NY

\\lovetongis\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 12-2 HTRW Project AOC Incremental Sampling Decision Units.mxd

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3. STATEMENT OF SAFETY AND HEALTH POLICY

EA's Corporate Safety and Health Policy is as follows:

EA considers the safety and health of its employees, clients, and visitors—as well as the prevention of work-related accidents and illnesses, property loss, and detrimental impact to the environment—to be of the highest priority. Proactively implemented, a comprehensive and systematic safety and health program will result in more efficient and profitable operations by improving employee health and morale, and by reducing Worker's Compensation costs, lost time, fire and liability insurance premiums, and property damage.

The objectives of EA's Safety and Health Program are to ensure:

- Sound safety and health practices and conditions necessary for the protection of the health and welfare of employees, subcontractors, clients, and visitors.
- Compliance with this APP, and federal and state safety and health regulations and standards.
- Effective safety, fire prevention, and work practices necessary for protection of company-owned or operated and site property.

EA is committed to the overall goal of having no workplace injuries or safety incidents at the Iona Island FUDS. A copy of EA's OSHA Form 300A – Summary of Work-Related Injuries and Illnesses for 2017 can be found in **Appendix B**.

EA's OSHA-recordable incident and lost-workday rates are comparable with the industry average. In addition, the insurance industry has developed an experience rating system as an equitable means of determining premiums for Workers' Compensation insurance (Experience Modification Rate). This rating is based on a comparison of firms doing similar types of work, with the employer rated against the average expected performance in each work classification. For the past 12 years, EA has been below the industry average. The last 5 years are provided in **Table 3-1**.

Table 3-1 Summary of EA Safety and Health Data

EA	2017	2016	2015	2014	2013
Experience Modification Rate	0.78	0.74	0.78	0.84	0.89
Number of Recordable Cases	7	5	4	4	1
Total Recordable Incident Rate	1.31	0.95	0.79	0.86	0.21
Total Hours Worked	1,072,638	1,055,170	1,008,144	924,925	952,444

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4. RESPONSIBILITIES AND LINES OF AUTHORITY

4.1 STATEMENT OF RESPONSIBILITY TO IMPLEMENT THE SAFETY AND HEALTH PROGRAM

EA is responsible for the implementation of a safety and occupational health program for protection of employees in the workplace and maintains full responsibility for the implementation of this APP. Site personnel are responsible for adherence to this APP and maintain stop-work authority at all times. The safety role of subcontractors is discussed in Section 5.2 and visitor safety is discussed in Section 6.

4.2 IDENTIFICATION AND ACCOUNTABILITY OF PERSONNEL

Personnel responsible for safety at corporate and project levels are listed below. Qualifications for onsite safety personnel shall include the OSHA 30-hour or equivalent course. Competency in performing several of the roles listed below is detailed on resumes and certifications provided in **Appendix C**.

4.2.1 Program Manager (Ms. Brenda Herman, P.G.)

The Program Manager will provide program management as the point-of-contact for the delivery order and will review safety plans, ensure client-specific safety and health requirements are followed, periodically monitor field operations, and communicate with safety personnel (listed below).

4.2.2 Business Unit Director (Mr. Gordy Porter)

The Business Unit Director is accountable for implementation of the safety and health program; may contractually obligate the company; ensures time and budget are applied to training; conducts periodic reviews of safety and health procedures; ensures employees follow safety and health procedures; and requires Project Managers to implement corrective actions, if necessary.

4.2.3 Project Manager (Mr. Timothy Reese, P.E.)

The Project Manager is accountable for allocating resources to the project to develop and implement this APP; direct corrective actions, if required; review/investigate work-related injuries and illnesses; and report accidents/incidents in accordance with requirements presented in Section 9. The Project Manager will assist in submission of safety-related documents for acceptance.

4.2.4 Director of Safety and Health and Safety and Health Manager (Mr. Peter Garger, CIH, CSP)

The SHM is accountable for development and enforcement of this APP/SSHP through oversight and implementation, audits and inspections, remaining available for project emergencies, modifications, evaluation of exposure monitoring, serving as a QC staff member, and approval of safety documents. The SHM is also accountable for providing expertise, opinion, and resolution to safety issues from employees; arranging and providing required safety and health training for workers within their region(s) of responsibility; assisting with investigation of accidents and near misses; ensuring medical surveillance program requirements are followed; ensuring monitoring programs are properly designed; and conducting hazard assessments documented through the generation of site-specific AHAs.

4.2.5 National Service Line Program Manager for Munitions Response (Mr. Richard Hanoski, Certified Quality Auditor)

The National Service Line Program Manager for Munitions Response (MR) will provide senior technical input on issues related to MR. He will also review the project plans and deliverables to identify any MR safety or QC concerns.

4.2.6 Site Safety and Health Officer (Eddie Meadows)

The Site Safety and Health Officer (SSHO) will be onsite in addition to the UXOSO/UXOQCS during air rotary drilling (otherwise the UXOSO/UXOQCS will serve as SSHO). They is accountable for ensuring onsite adherence to the APP/SSHP; mitigating unsafe work conditions; proper application of monitoring equipment; leading initial onsite investigations of accidents, near misses, and occupational illnesses; providing incident reports to project management; confirming qualifications and training of onsite personnel; performing onsite safety-related briefings and inspections; and investigating onsite hazardous conditions. The alternate SSHO is Jeff Smith.

4.2.7 Field Data Manager/Site Supervisor for HTRW RI (Mr. Joseph Von Uderitz, P.G.)

The Field Data Manager/Site Supervisor is accountable for reporting to project management; confirming adherence to sampling and analysis plans and/or work plans; coordinating activities with the Senior Unexploded Ordnance Supervisor (SUXOS), SSHO or the UXO Safety Officer (UXOSO)/QC Specialist (QCS); reviewing and comparing quality measurements against objectives; managing subcontractors; and providing documentation of daily safety inspections.

4.2.8 Munitions and Explosives of Concern Avoidance and Munitions and Explosives of Concern Investigation and Surface Clearance Personnel for Land-Based Activities

4.2.8.1 Senior Unexploded Ordnance Supervisor (Mr. John “JD” Marlowe)

The SUXOS is accountable for supervising MEC investigation; implementing all MR-related plans and field activities; providing work briefings when necessary; and recording daily MR-related activities.

4.2.8.2 Unexploded Ordnance Safety Officer and Quality Control Specialist (Mr. John Monk and Mr. Ward Stern [alternate])

The UXOSO/UXOQCS is accountable for reporting to the SHM for safety and to the Project QA/QC Manager and the Corporate QA/QC Manager for QC during MEC clearance activities. The UXOSO/UXOQCS will operate in conjunction with the SSHO during MEC activities and will execute the safety and QC requirements of the Explosives Site Plan (submitted under separate cover); implement MEC-related safety procedures; notify local public emergency agencies, including the fire department and/or police, of the onsite operations as required; update safety procedures; and recognize MPPEH.

4.2.8.3 Munitions and Explosives of Concern Support Personnel (TBD)

A UXO Technician III will lead each UXO team and is accountable for following safety and health rules and regulations; following procedures, controls, and safety devices including personal protective equipment (PPE); notifying the UXOSO, if encountering new hazards; and reporting any incidents to the UXOSO, as applicable. UXO Technician IIIs, UXO Technician IIs and/or UXO Technician Is will be used for intrusive investigation of anomalies, surface clearance of land-based geophysical areas and/or anomaly avoidance tasks in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper 18.

4.2.9 Diving Personnel

The roles of diving personnel including the Direct Person in Charge (DPIC) (SUXOS Qualified) and UXOSO/UXOQCS will be included in the Dive Operations Plan (**Appendix H, to be submitted as a separate addendum**). Their resumes, qualifications, and certifications will be submitted via a separate addendum.

4.2.10 Supervisors and Employees

Supervisors are accountable for ensuring employees receive training in hazard recognition and safe work practices, periodically monitoring activities to ensure conformance with training, investigating/reporting incidents, investigating employee reports of hazardous conditions, and mitigating hazardous conditions. Employees, including subcontractors, are accountable for following the training, following safe work practices, notifying the SSHO and/or UXOSO, as applicable and Supervisors of new hazardous conditions, reporting incidents, and participating in pre-task/pre-entry/onsite training. Specific safety responsibilities of subcontractors are addressed in Section 5.

4.3 COMPETENT AND/OR QUALIFIED PERSONS

The following personnel are designated as Competent and/or Qualified Persons to complete the scope of services at the Iona Island FUDS. Proof of competency is provided using resumes and certifications presented in **Appendix C**. The designated competent/qualified persons are included in the AHAs presented in **Appendix A**. Alternates are presented in Section 4.2. The list of training and certifications of personnel required to complete this work, and documentation requirements, are presented in Table 6-1. The SSHO and/or UXOSO are responsible for maintaining current copies of certifications and training of onsite personnel.

The personnel, roles, and their competencies are presented below:

- ***Mr. Peter Garger, CIH, CSP (SHM)***—Review and approve the APP and SSHP, hazard identification, resolution of unanticipated safety issues, and forwarding safety documents and/or resolutions to USACE–Baltimore for acceptance.

- ***Mr. Michael McGuire*****—**Qualified person as the Senior Geophysicist.

- ***Ms. Denise Wilt*****—**Qualified person as the Plan Preparer.

- ***Mr. Eddie Meadows or Mr. Jeff Smith (SSHO for HTRW RI Intrusive Activities)***—Onsite for intrusive (drilling) and non-intrusive HTRW RI activities. The SSHO has a minimum of 5 years experiencing implementing Safety and Occupational Health procedures, OSHA 30-hour Construction Safety class, 40-hour initial and 8-hour Supervisor training and maintains 8-hour refresher training.

- ***Mr. Joe Von Uderitz (Site Supervisor for geophysics/non-UXO activities)***—Onsite for geophysics, target acquisition and non-UXO related activities (i.e., geophysics in areas with surface clearance completed).

- ***Mr. John "JD" Marlowe (SUXOS for land-based operations)***—Qualified SUXOS for land based MEC-related activities. Mr. Marlowe meets the requirements of DDESB Technical Paper 18 for a SUXOS and will ensure all MEC-related personnel meet the appropriate DDESB Technical Paper 18 requirements for their role.

- ***Mr. John Monk and Mr. Ward Stern (UXOSO/UXOQCS)***—Qualified Person for safety and QC for surface clearance and intrusive investigation activities. Mr. Monk meets the requirements of DDESB Technical Paper 18 (**Table 4-1**) for UXO Qualified Personnel. Mr. Monk will function as the UXOSO/UXOQCS for land-based activities.

- ***Direct Person In charge (SUXOS qualified) (TBD)*****—**Qualified Person for diving supervisor. Qualified Personnel for MEC-related diving activities. The DPIC diving supervisor will meet the requirements of DDESB Technical Paper 18 for UXO Qualified Personnel for the SUXOS responsibility. The DPIC and will ensure all MEC-related personnel meet the appropriate DDESB Technical Paper 18 requirements for UXO Qualified Personnel and technicians. Qualifications will be submitted via addendum in conjunction with the dive plan.

- ***UXOQCS/UXOSO (TBD)*****—**Qualified Person for the DPIC position. Qualified Personnel for MEC-related diving activities. The DPIC will have the qualifications and certifications for the UXOQCS/UXOSO position as per DDESB Technical Paper 18 for UXO Qualified Personnel. Qualifications will be submitted via addendum in conjunction with the dive plan.

Additional competent or qualified persons identified or provided by subcontractors will be identified prior to the initiation of that task and will be presented in the AHAs and/or subsequent addenda. All personnel will need to satisfy the training, certification, and inspection requirements highlighted in Sections 5, 6, and 7, respectively.

4.4 REQUIREMENT FOR WORK STOPPAGE WITHOUT COMPETENT PERSON

No work requiring an OSHA-defined competent person shall be performed unless the designated and accepted competent person or their approved alternate is present on the job site for the task being conducted. All site personnel have stop-work authority. Competent persons are listed on each AHA.

4.5 REQUIREMENTS FOR PRE-TASK SAFETY AND HEALTH ANAYLSIS

The SHM has evaluated the activities associated with implementation of the site work and have determined potential hazards associated with the activities. The results of the hazard analysis and associated controls are documented using AHAs (**Appendix A**). As part of the three-phase control process, AHAs will be submitted and accepted at the pre-mobilization preparatory meeting. In addition, site personnel will be required to review this APP and associated supplemental plans and will be given a pre-entry/pre-construction briefing on the contents of the APP and associated supplemental plans. The SSHO and/or UXOSO/UXOQCS will provide the pre-entry/pre-construction briefing, which will include discussion of the following items:

- Site description
- Site control measures
- Emergency response plan and procedures
- General and task-specific hazards and hazard controls including AHAs
- Task-specific PPE requirements
- Task-specific environmental monitoring requirements and action levels
- Lines-of-authority and communication
- Stop work authority in cases of safety non-compliance
- Hazard Communication Program
- Location of hazardous materials
- Identification and recognition of hazardous materials
- Physical and health hazards of hazardous materials
- Protective measures when working with hazardous materials.

General MEC safety briefings will be given by the UXOSO to inform the MEC clearance project team of the site-specific MEC hazards. When there are activities requiring only anomaly avoidance (no MEC investigation or construction support), the most senior UXO Technician (Technician III or II) will give the MEC safety briefing. For other activities, such as mobilization, demobilization, surveying, or brush cutting/removal, the SSHO and/or UXOSO, as applicable may perform the briefing.

4.6 LINES-OF-AUTHORITY

EA maintains separate lines of reporting for technical task management and safety in order to limit conflicts of interest between the need to maintain safety and maintain project deliverables, budget, and schedule. Safety personnel have the authority to require and implement changes with regard to site safety and all site personnel maintain stop-work authority. Depending on the phase of work, the UXOSO/UXOQCS and/or SSHO will report safety issues to the SHM. The SHM, in addition to the SSHO and UXOSO/UXOQCS, can request changes to the APP. The SHM will inform the Program Manager and Project Manager of the required changes.

If there is disagreement between safety and management at the SSHO/UXOSO and Project Management level, the disagreement will be elevated to the Director of Safety and Health and the Program Manager for resolution. The Director of Safety and Health and the Program Manager have the ability to elevate safety issues to EA's President/Chief Executive Officer, if required, for resolution. Work related to the identified safety issue or hazard will not resume until a safe resolution is agreed upon. The USACE Project Manager will be notified by the Project Manager of safety issues that result in a work stoppage or required change to the APP.

Table 4-1 and **Figure 4-1** present project personnel, their involvement on the project, the organization these individuals represent, and contact information. **Figure 4-2** presents the telephone notification process if MEC are found.

4.7 NON-COMPLIANCE WITH SAFETY REQUIREMENTS

EA expects and requires that employees and subcontractors will adhere to this APP and associated supplemental plans. Progressive disciplinary action is used to deal with non-compliance issues. For EA employees, this includes the following:

- First offense will warrant a verbal warning, explanation of why the activity was non-compliant, and reference the section of the APP where the activity lacking compliance was presented.

- A second offense, if it is of the same nature, will warrant a written warning and may lead to removal from the job site. If the second offense is not the same non-compliance issue as the first, additional explanation of why the activity was non-compliant will be discussed and the employee will be required to re-review the APP.

- A third offense will lead to removal from the job site.

- If additional offenses are perpetrated on other project sites, the employee may be suspended or terminated.

If subcontractors are non-compliant with safety requirements, they will be given verbal and written warnings for the first two offenses. If additional offenses occur, the subcontractor may be removed from the project site.

4.8 COMPANY PROCEDURES FOR MANAGER AND SUPERVISOR ACCOUNTABILITY FOR SAFETY

EA's commitment to safety and health is documented, and requirements addressed, from the time an offer of employment is made to a job applicant. Managers and supervisors are made responsible for enforcing safety and health as part of their job descriptions. They are ultimately responsible for protecting the health and welfare of the employees, as well as minimizing the potential liability associated with on the job or work-related accidents.

A manager or supervisor has the authority to assign and direct personnel on project tasks. As such, the Project Manager, Field Data Manager/Site Supervisor, SUXOS, UXOSO/UXOQCS, and SSHO will possess knowledge of the correct safe procedures for tasks that will be performed under their supervision. If there is question as to the appropriate safety measures, the SSHO, UXOSO/ UXOQCS, Field Data Manager/Site Supervisor, SUXOS, or Project Manager will seek assistance from the SHM. If any task cannot be accomplished safely, it will not be attempted.

In addition, at a minimum of once per year, each employee's performance is formally evaluated in the following areas: personal commitment to safe work practices, adherence to established health and safety plans and programs, ability to recognize safety hazards, communication skills, acquisition and proper use of PPE and monitoring equipment, and proper budgeting for safety and health aspects in projects.

Unsatisfactory performance in any of the above areas by supervisors or managers is addressed through implementation of performance improvement plans; mandatory additional training; lower overall compensation; and, if appropriate, termination.

Table 4-1 Contact Information of Key Personnel

Project Personnel	Role	Phone Number	Email Address
Kathryn Brown	USACE KO	410-962-2585	Kathryn.E.Brown@usace.army.mil
Sesh Lal	USACE COR	410-962-2778	Sesh.P.Lal@usace.army.mil
Erin Kirby, P.G., LEP	USACE Project Manager	978-318-8147	Erin.Kirby@usace.army.mil
Todd Beckwith	USACE Technical Manager	410-962-6784	Todd.T.Beckwith@usace.army.mil
Marty Holmes	USACE Chief, Environmental and Explosives Safety Section	315-525-1195	Marty.a.holmes@usace.army.mil
Steven M. Scharf, P.E.	NYSDEC	845-786-2701	steven.scharf@dec.ny.gov
Edwin McGowan	PIPC Science Director	845-786-2701	edwin.mcgowen@parks.ny.gov
Brenda Herman, P.G.	EA Program Manager	410-527-2474	bherman@eaest.com
Richard Hanoski	EA STR, Deputy EA Program Manager	443-632-4887	rhanoski@eaest.com
Timothy Reese, P.E.	EA Project Manager	410-935-3887	treese@eaest.com
Amanda Kohn	EA Deputy Project Manager	315-565-6548/ 315-506-2556	akohn@eaest.com
Michael O'Neill	EA STR	410-329-5142	moneill@eaest.com
Michael McGuire	EA Geophysics Program Lead	443-986-2488	mmcguire@eaest.com
Peter Garger, CIH, CSP	EA Certified Industrial Hygienist	410-527-2425 / 410-790-6338	pgarger@eaest.com
Frank DeSantis, Jr.	EA Regulatory Specialist	315-565-6554	fdesantis@eaest.com
Mark Howard	ANJV AGC Project Manager	434-978-3187	mhoward@naevageophysics.com
Ben Dameron	ANJV QC Geophysicist	434-978-3187	bdameron@naevageophysics.com
Dean Keiswetter	ANJV QA Manager Geophysicist	919-454-4774	dkeiswetter@acornsi.com
Alex Kostera	ANJV Senior Geophysicist	434-825-0934	akostera@naevageophysics.com
Brandon Puttroff, P.E.	AOR Project Manager	619-203-7325	Brandon.Puttroff@aorintl.com
Steve Mulholland	AOR DPIC (Waterborne SUXOS)	619-559-5888	Steve.mulholland@aorintl.com
John "JD" Marlowe	EA SUXOS	443-752-1775	jmarlowe@eaest.com
John Monk	EA UXOSO/UXOQCS	717-887-5582	jmonk@eaest.com
Ward Stern	EA UXOSO/UXOQCS Alternate	256-731-9151	wrstern@tecoptic.com
Eddie Meadows	EA SSHO	410-671-6051	emeadows@eaest.com
Jeff Smith	EA SSHO Alternate	410-671-6051	jsmith@eaest.com
Joseph Von Uderitz, P.G.	EA HTRW Field Team Leader	315-565-6567 / 315-382-9534	jvonuderitz@eaest.com

NOTES:
COR = Contracting Officer's Representative
KO = Contracting Officer
LEP = Licensed Environmental Professional
PMP = Project Management Professional
NYSDEC = New York State Department of Environmental Protection
STR = Senior Technical Review
DPIC=Direct Person in Charge

Figure 4-1 Lines of Authority for EA Corporate and Site Activities (Safety)

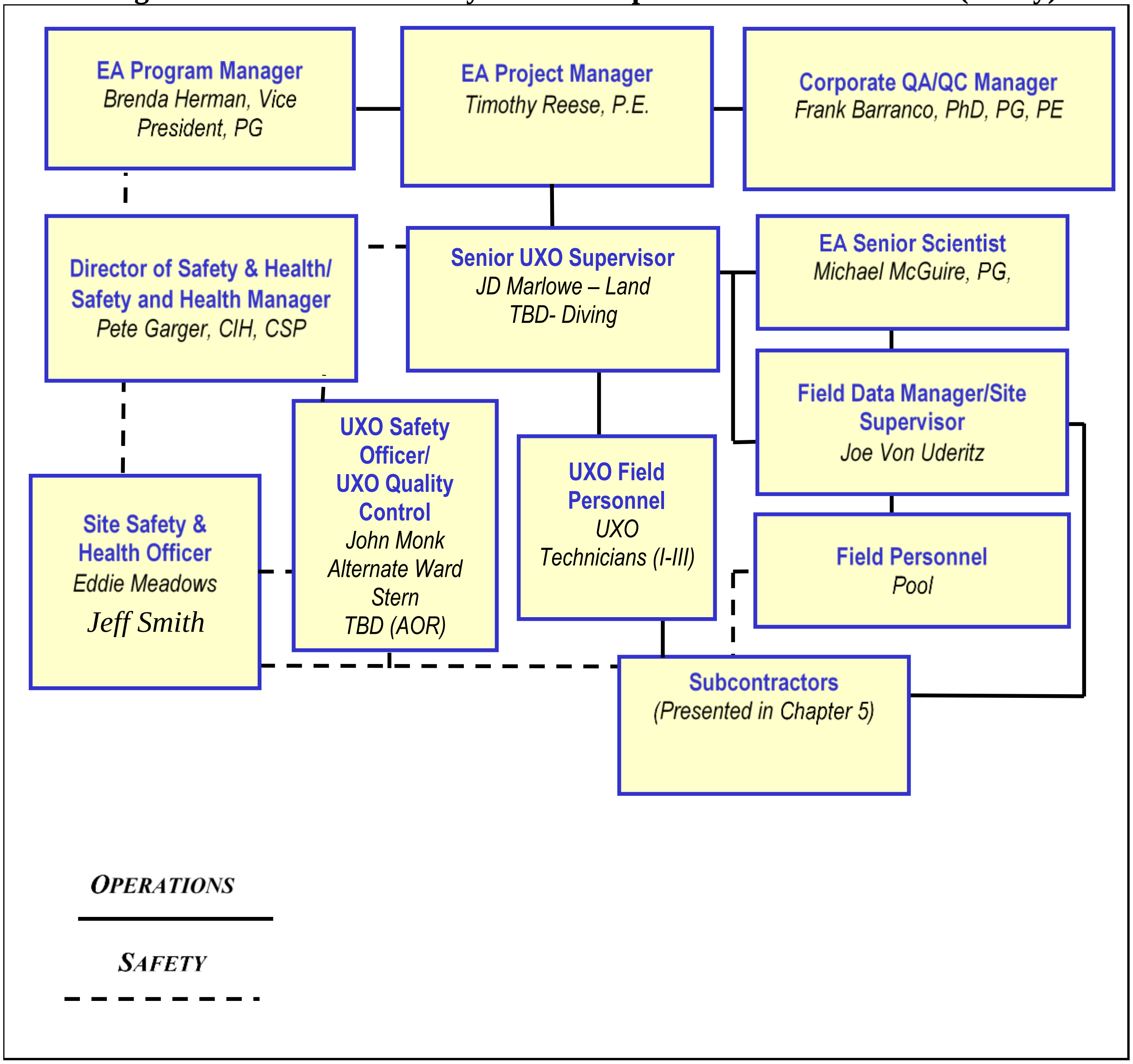
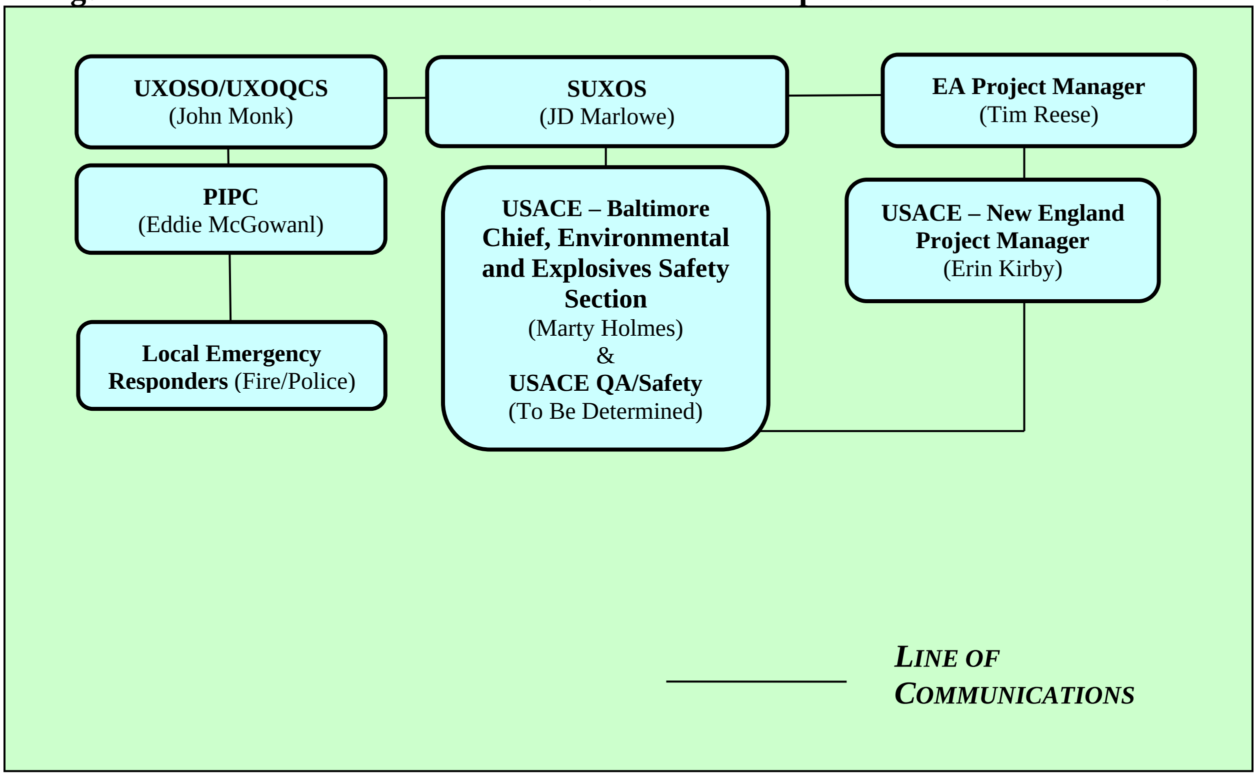


Figure 4-2 Phone Tree Notification if Munitions and Explosives of Concern are Found



5. SUBCONTRACTORS AND SUPPLIERS

5.1 IDENTIFICATION OF SUBCONTRACTORS AND SUPPLIERS

Subcontractors and suppliers currently identified to assist in onsite implementation of the project include:

- Water Based MEC Intrusive Investigation: AOR
- Geophysical Support (DGM and AGC): ANJV
- Professional Land Surveyor: Morris Associates, PLLC
- Drilling: Cascade Technical Services
- Material Documented as Safe (MDAS): American Explosive Ordnance Disposal Services (AEODS)
- Donor Explosives Provider: Tripwire
- Analytical Laboratory: TestAmerica Laboratories, Inc. (recently acquired by Eurofins)
- Data Validation: Environmental Data Services, LTD.

Competent/qualified persons will follow the requirements of this document. Coordination and safety responsibilities of subcontractors are presented below. Offsite work conducted by subcontractors is not covered by this APP. The subcontractor for the surveying task is not known at this time, but additional information will be submitted to the APP for acceptance prior to the start of any activities listed.

5.2 SAFETY RESPONSIBILITIES OF SUBCONTRACTORS AND SUPPLIERS

Subcontractors and suppliers providing onsite services will be required to review and abide by this APP. Subcontractors report to the SUXOS or Field Data Manager/Site Supervisor Specific responsibilities of subcontractors include:

- Complying with the requirements of their scope of work
- Maintaining a safe and healthy work environment
- Reporting of any unsafe conditions
- Reporting of any accidents

- Complying with contract flow down requirements, laws, regulations, and USACE safety guidance documents
- Reviewing this APP to ensure that the safety and health requirements of their specific tasks are satisfied
- Performing work in accordance with the APP requirements
- Providing trained and experienced workers for the specific work activities (e.g., diving).
- Providing documentation of training to EA
- Participating in the pre-entry site briefing and daily safety tailgate meetings
- Identifying additional training needs for unique tasks
- Participating in, and documenting, routine equipment and site inspection activities
- Providing documentation to the SUXOS/Field Data Manager/Site Supervisor/SSHO/UXOSO that materials and equipment brought to the site are in good condition, routinely inspected, maintained in safe working order and meets, or exceeds, required project specifications.

6. TRAINING

EA will ensure site personnel and supervisors have received the required training to complete the pertinent phases of work in a manner that is consistent with the Safety and Health Policy goals and objectives highlighted in Section 3 and state and federal standards. All employees and supervisors working on the Iona Island RI project receive safety and occupational health training upon hire and annually thereafter.

The SSHO and/or the UXOSO/UXOQCS will ensure that all employees engaged in site operations are informed regarding the nature and degree of exposure to chemical, physical, and biological hazards likely to result from participation in site operations. EA will accomplish this by ensuring that all personnel entering the site have received the appropriate training required to safely complete site-specific work prior to participation in site activities. OSHA-required training will be conducted prior to site mobilization and is documented through the resumes and certifications presented in **Appendix C**.

EA will conduct daily safety briefings summarizing site-specific activities and the training required to complete the onsite work. Site workers will have received the required training prior to the start of involvement in site activities and are required to attend daily safety briefings. Documentation of training, update frequency of training, time of initial training, training types, and personnel receiving the training are presented in **Table 6-1**. Training requirements for diving activities are included in Section 5.1 of the Dive Safety Plan (**Appendix H, to be submitted as an addendum**).

The SSHO and/or UXOSO, as applicable will brief all visitors to the site on the site hazards and controls. All visitors will be required to sign a visitor log and will be escorted at all times by the Field Data Manager/Site Supervisor, SSHO, SUXOS, or UXOSO/UXOQCS as appropriate depending on the ongoing activity.

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Table 6-1 Mandatory Training and Certifications

Personnel	Training	When	Update Frequency[a]	Documentation
APP Preparer/Project Manager/APP Reviewer	EA APP Training	Initially	Annually	Corporate Files
Personnel	Safety and Occupational Health Training (29 CFR 1910.120 (e)-compliant 40-Hour HAZWOPER)	Upon hire	Refer to 8-hour Refresher below	Corporate Files
HAZWOPER-Trained Personnel	Medical Clearance (Medical Monitoring)	Upon hire	Annually	Corporate Files
HAZWOPER-Trained Personnel	Annual Health and Safety Refresher (29 CFR 1910.120 (e)-compliant 8-hour HAZWOPER Refresher training)	One year after initial training	Annually after 40-hour HAZWOPER	Corporate Files
At least two onsite employees	First Aid/Cardiopulmonary Resuscitation (CPR) including automatic external defibrillator training (AED) (in person, not online)	Initially	Biannually	Corporate Files
First Aid/CPR Providers	OSHA 1910.1030-compliant bloodborne pathogens	Prior to onsite work	Annually	Corporate Files
SSHO	At least 24 hours of formal safety and health training every 4 years	Aggregate training requirement	4-year total	Corporate Files
SSHO	8-Hour Supervisor Training (includes 8-hour HAZWOPER Supervisor Training)	Prior to mobilization	Does not expire	Corporate Files Appendix C
SSHO	OSHA 30-hour Construction Safety Course and as per DDESB TP-18	Prior to mobilization	Does not expire	Corporate Files
Personnel	Emergency Response Training (Requirements in Section 9.2)	Prior to onsite work	Prior to onsite work; if retraining required	APP Review Form
Personnel	Use of Fire Extinguishers	Annually and prior to onsite work	Annually	Corporate Files
Personnel	Use of PPE	Annual and prior to onsite work	Annually; prior to onsite work; if retraining required[b]	PPE Training Form
Personnel	Pre-Entry Site Briefing	Prior to onsite work	Not applicable	APP Review Form
Personnel	Daily Tailgate Safety Meeting (Topics Exceed Monthly/Weekly Meeting)	Daily	Not applicable	Daily Tailgate Safety Form
Personnel	Hot/Cold (as applicable) Environments Training	Prior to onsite work	Not applicable	Daily Tailgate Safety Form
Mobile Construction Equipment	Valid Driver’s License	NA	Varies by Individual (On License)	Driver’s License
All Employees	MEC-Awareness (by UXOSO)	Initial	Not applicable	Daily Tailgate Form; Daily Operational Journal
EA and USACE	Safety Pre-Work Conference	Prior to onsite work	Not applicable	Meeting Minutes
Supervisors	Monthly Safety and Health Training and Planning Meeting [c]	Monthly	Not applicable	Annotation on Daily Tailgate Safety Form

Table 6-1 Mandatory Training and Certifications

Personnel	Training	When	Update Frequency[(a)]	Documentation
Visitors and Authorized Entrants	Visitor Briefing (by SSHO and/or UXOSO, as applicable) (escort by Field Data Manager/Site Supervisor, SSHO, SUXOS, or UXOSO/ UXOQCS)	Prior to observing onsite work	Once per visit	Visitor's Log
Vehicle Operators	Valid Driver's License	Prior to work onsite	Based on State Issuing License	Driver's License
Boat Operators	National Association of State Boating Law Administrators Small Boat Certification	Prior to work onsite	Not applicable	Corporate Files
UXO Technicians	In accordance with Department of Defense Explosive Safety Board Technical Paper-18	Prior to work onsite	Not applicable	Resumes in Corporate files

(a) Currently, EA uses an automated system to notify the Director of Safety and Health/Safety and Health Manager and the employee when a training or certification is about to expire. Employees are required to communicate their plan to update the training/certification with the Director of Safety and Health and will be provided with resources to meet training/certification requirements.
(b) Retraining requirements are at the discretion of health and safety personnel.
(c) In the event that any field events last longer than 1 month.

NOTES:
CPR = Cardiopulmonary resuscitation

7. SAFETY AND HEALTH INSPECTIONS

Periodic safety and health-related inspections are required at the Iona Island FUDS. **Table 7-1** summarizes inspectors, frequency of the inspections, and documentation. The qualifications of the inspectors stated in **Table 7-1** are presented in **Appendix C**. If a deficiency is found during the inspection process, the SSHO or UXOSO will note the date the deficiency was identified, a description of the deficiency, name of the person responsible for correcting the deficiency, the projected date of correction, and, once corrected, the date the deficiency is actually resolved. This information will also be recorded in chronological order on a deficiency log kept with the APP onsite. Deficiency logs and documentation of daily safety inspections and briefings will also be submitted to USACE Project Manager, Ms. Erin Kirby and to USACE Technical Manager, Mr. Todd Beckwith. The SSHO or UXOSO will perform a follow-up inspection and note the corrective measures taken and the date the correction was completed. The deficiency, follow-up actions, and statuses will be noted on the Daily Safety Inspection Checklist and the deficiency will be discussed during subsequent Daily Tailgate Safety Briefings. No external inspections or certifications are required to complete the work in this PWS.

A summary of inspections is presented in **Table 7-1**, and the forms to document the inspections are presented in **Appendix D**. Diving related inspection are included in the Dive Safety Plan (**Appendix H**).

Table 7-1 General Safety and Health Inspection Requirements

Personnel[a]	Inspection	Timing/ Frequency	Documentation[c]
SSHO/UXOSO	General Site Conditions (e.g., vehicles, documents, etc.)	Initial and Daily	Initial Safety and Health Inspection Checklist Daily Safety and Health Inspection Checklist Health and Safety Activity Report
	PPE	Initial and Daily	Initial Safety and Health Inspection Checklist Daily Safety and Health Inspection Checklist Dispose of PPE, if faulty
	Emergency Equipment: • Fire Extinguisher • First Aid Kit	Initial and Monthly	Initial Safety and Health Inspection Checklist Monthly Safety and Health Inspection Checklist
	Exposure Hours	Daily (Monthly)	Site Entry and Exit Log (Logged daily and reported monthly)
	Physiological Monitoring (Heat Stress Prevention)	Hourly[b]	Daily Environmental Monitoring Record
	Physiological Monitoring (Heat Stress Prevention) (Employees in Level C)	Hourly[b]	Daily Environmental Monitoring Record
	Air Temperature and Wind Speed (Cold Stress Prevention)	Hourly[b]	Daily Environmental Monitoring Record
All Employees	PPE	Before Use	None. Dispose of PPE if faulty
Operator	Boat	Daily	Inspection Form
UXO Technicians	Magnetometer	Before Use	Daily Operations Journal. Tag defective items "out of service." Replace with new unit.
SHM	Fire Prevention Plan Survey	Annual	Fire Prevention Plan Audit
SHM	Safety and Health Audits	Random	EA Corporate Audit Forms
Operators	Mobile Construction Equipment	Daily	Daily Equipment Inspection Form
Drillers	Drill Rigs	Daily	Cascade Inspection Form or USACE Drill Inspection Form
All Employees	Tools and Equipment	Before Use	None. Dispose/replace faulty equipment/supplies.
SSHO/UXOSO	General Safety and Health	Daily	Daily Safety and Health Inspection Checklist

(a) Personnel associated with titles are presented in Section 4.
(b) Monitoring frequency is weather-dependent and presented in the SSHP (**Appendix E**).
(c) Any deficiencies and related information will also be recorded in chronological order on a deficiency log posted in the site trailer in accordance with Section 7.

8. MISHAP REPORTING AND INVESTIGATION

EA will track exposure hours, mishap notifications and reporting, and accident investigations at the Iona Island FUDS.

8.1 FIELD EXPOSURE DATA REPORTING

EA will monitor employee exposure hours using the Site Entry and Exit Log (**Appendix D**). Site personnel are required to sign-in and sign-out each time they enter and exit the site. These hours will be tallied monthly and will be provided to the EA Project Manager. EA will report contractor field exposure hours (total hours onsite including unpaid hours and individual subcontractor hours) monthly to USACE. Reporting will be completed by the EA Project Manager or their designee. The EA Project Manager will provide these data to the USACE Safety Manager (copying the USACE Project Manager and USACE Technical Manager) by the 10th day of the subsequent month.

8.2 MISHAP REPORTING AND INVESTIGATION

A mishap is defined as any unplanned, undesired event that occurs during the course of work being performed. Mishaps include accidents, incidents, and near misses. Employees will immediately report all mishaps to the SSHO/UXOSO and Field Data Manager/Site Supervisor who will report the accident to the Project Manager, Supervisors, Director of Safety and Health/SHM, Program Manager and Human Resources. The SSHO/UXOSO will complete the EA Accident/Loss Report and submit it immediately to the Director of Safety and Health, Program Manager and the Project Manager. The Project Manager will report to the USACE Project Manager/COR. All recordable mishaps must be communicated to the USACE Project Manager/COR as soon as possible and within 24 hours of the accident with the exception of the following events, which must be reported immediately: fatality, permanent partial or total disability, hospitalization of one or more people from a single incident, or property damage of $500,000 or more.

EA is also responsible for reporting property damage (exceeding $5,000 is recordable), days away injuries, days away illnesses, and restricted/transfer injuries to USACE. In addition, EA is responsible for reporting any fatality to the New York State Department of Health within 8 hours and any inpatient hospitalization, amputation, or eye loss within 24 hours.

Any mishap occurring in any of the following high hazard areas will be immediately reported to the USACE Project Manager/Contracting Officer’s Representative:

- Electrical (e.g., arc flash, electrical shock, etc.)
- Uncontrolled release of hazardous energy (electrical and non-electrical)
- Load handing equipment or rigging
- Fall-from-height (any level than the same surface)
- Unintentional detonation of UXO
- Diving accidents.

The above mishaps will be investigated in depth to identify all causes and to recommend hazard control measures.

An accident investigation will be conducted for all mishaps. Reportable accidents will be investigated by the SHM including: occupational injuries and illnesses; accidents resulting in significant loss or damage to property; accidents involving vehicles whether or not they result in damage to property or personnel; and accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property ("near miss"). Minor accidents will be investigated by the SSHO/UXOSO. An accident investigation will be used to determine and implement corrective actions, identify the causal factors contributing to the accident, identify deficiencies to the APP, provide information to identify trends or problem areas, and follow requirements for Workers' Compensation and/or OSHA recordkeeping and reporting. Results of the accident investigation along with the appropriate corrective actions will be sent to the USACE Project Manager as soon as possible and within 5 working days using the USACE Accident Investigation Form (ENG3394)[1].

The SSHO/UXOSO will provide the Director of Safety and Health/SHM and the Project Manager with an update once the corrective action has been implemented. The EA Project Manager will notify the USACE Project Manager of the status of the corrective action. Contact information for individuals involved in accident reporting procedures is presented in Section 9.2.2.

[1] http://www.swg.usace.army.mil/Portals/26/docs/Safety/ENGForm3394AccidentInvestigationForm.pdf

9. SUPPLEMENTAL PLANS

The tasks listed in **Table 2-1** have been evaluated to determine the applicability of plans required by Appendix A of EM 385-1-1 (USACE 2014). **Table 9-1** summarizes the findings of this evaluation and indicates the location of required plans.

Table 9-1 Summary of EM 385-1-1 Plan Evaluation

Plans Per Appendix A of EM 385-1-1 (November 2014)	Rationale for Inclusion or Exclusion	Location if Included
Fatigue Management Plan	Included in the event that triggers for plan occur during the course of work.	9.1
Emergency Plans • Procedures and Tests • Spill Plans • Fire Fighting Plan • Posting of Emergency Telephone Numbers • Man overboard/abandon ship	Applicable to all operations.	 9.2.1 9.2.3 9.2.4 9.2.2 Refer to Appendix G
Plan for Prevention of Alcohol and Drug Abuse	Applicable to all operations.	9.3
Site Sanitation/Housekeeping Plan	Applicable to all operations.	9.4
Medical Support Agreement	Applicable to all operations	9.5
Site-Specific Bloodborne Pathogen Plan	Applicable to all operations.	9.6
Exposure Control Plan	Applicable to all operations.	9.6
AED Program	An AED will be on board the boat during diving activities.	9.7
Site Layout Plan	Completion of this PWS requires the placement of restroom facilities and a temporary storage container.	9.8
Access and Haul Road Plan	Access to the site project site is via existing roads within the National Park. No haul roads are necessary for the completion of the PWS.	Not applicable
Hearing Conservation Program	Applicable to potentially loud operations.	9.9
Respiratory Protection Plan	Respirators will not be utilized for the PWS.	9.10
Health Hazard Control Program	Applicable to all operations.	9.11
Hazard Communication Program	Applicable to operations with hazardous chemicals.	9.12
Process Safety Management Plan	Not required under the current scope of work because it does not include the use or storage of any highly hazardous chemicals.	Not applicable
Lead Compliance Plan	Not required under the PWS because it does not include lead hazard control activities.	Not applicable
Asbestos Abatement Plan	Not required under the PWS because it does not include asbestos abatement activities.	Not applicable

Table 9-1 Summary of EM 385-1-1 Plan Evaluation

Plans Per Appendix A of EM 385-1-1 (November 2014)	Rationale for Inclusion or Exclusion	Location if Included
Radiation Safety Program	Not required under the current PWS because it does not include the handling of radioactive material or the use of radiation generating devices.	Not applicable
Abrasive Blasting Plan	Not required under the PWS because it does not include the abrasive blasting.	Not applicable
Heat Stress Monitoring Plan	Applicable.	Section 8.1 of the SSHP (Appendix E)
Cold Stress Monitoring Plan	Applicable.	Section 8.2 of the SSHP (Appendix E)
Indoor Air Quality Management Plan	Not applicable, no indoor spaces.	Not applicable
Mold Remediation Plan	Not required, no remediation of mold.	Not applicable
Chromium (VI) Exposure Evaluation	A Chromium (VI) Evaluation is not required under the current scope of work because it does not include the cutting or breaking up of cement surfaces made from Portland cement with a high chromium content, painting or paint removal operations, welding using rods or wire with a chromium coating, heading or welding on stainless steel, and handing or applying anti-corrosive substances or coatings.	Not applicable
Crystalline Silica Assessment	No activities that could potentially generate crystalline silica (e.g. drilling/sawing concrete, mixing concrete) will be done under the PWS.	Not applicable
Light Plan for Night Operations	Not required under the current scope of work because all work will be scheduled during daylight hours.	Not applicable
Traffic Control Plan	Not required under the current scope of work because work is being conducted in areas away from vehicular traffic.	Not applicable
Fire Prevention Plan	Applicable.	9.13
Wild Land Fire Management Plan	Iona Island is not prone to wild land fire.	Not applicable
Arc Flash Hazard Analysis	An arc flash is a type of electrical explosion that results from a low-impedance connection to ground or another voltage phase in an electrical system. Whenever work on or near energized parts greater than 50 volts is necessary, a hazard analysis/arc flash hazard analysis is to be conducted in accordance with National Fire Protection Association 70E. No work on or near energized parts greater than 50 volts is anticipated under the PWS; therefore, a plan is not required.	Not applicable
Assured Equipment Grounding Control Program	All 120-volt, single phase, 15- and 20-ampere receptacle outlets on the job site, which are not part of the permanent wiring of a building or structure and which are in use by EA employees, shall have approved GFCIs for personnel protection; therefore, an assured equipment ground control plan is not required.	Not applicable

Table 9-1 Summary of EM 385-1-1 Plan Evaluation

Plans Per Appendix A of EM 385-1-1 (November 2014)	Rationale for Inclusion or Exclusion	Location if Included
Hazardous Energy Control Program and Procedures (Lock-Out/Tag-Out)	Tasks under the PWS do not require lock-out/tag-out.	Not applicable
Standard Pre-Lift Plan	Not required, no critical lifts are anticipated to complete the PWS.	Not applicable
Critical Lift Plan	Not required, no critical lifts are anticipated to complete the PWS.	Not applicable
Naval Architecture Analysis – Load Handling Equipment (Floating)	Not required, no load handling equipment on barges, pontoons, or vessels is required to complete the PWS.	Not applicable
Floating Plant Inspection and Certification	Applicable	Appendix G
Severe Weather Plan for Marine Activities	Applicable	Appendix G – Float Plan[1]
Emergency Plan for Marine Activities	Applicable	Appendix G
Man Overboard/Abandon Ship Procedures	Applicable	Appendix G
Float Plan for Launches, Motorboats, and Skiffs	Applicable	Appendix G – Float Plan
Fall Protection and Prevention Plan	Not applicable, no elevated work will be performed under the PWS.	Not applicable
Demolition/Renovation Plan	Not applicable, no demolition or renovation work will be performed under the PWS.	Not applicable
Rope Access Work Plan	Not required, no climbing activities are anticipated.	Not applicable
Excavation and Trenching Plan	The scope of work will involve the removal of less than 5 feet of soil from the surface for proposed test excavations based on the anticipated depth to bedrock. Based on the requirements stated in EM 385-1-1 25.A.01.a[1] an Activity Hazard Analysis (Appendix A) is required and an Excavation and Trenching Plan is not required. No excavation and trenching plan will be submitted for this PWS.	Not applicable
Fire Prevention and Protection Plan for Underground Construction Compressed Air Work Plan for Underground Construction	Not required, no underground construction activities are anticipated	Not applicable
Erection and Removal Plan for Formwork and Shoring	Not required, no use of formwork or shoring required for this PWS.	Not applicable
Precast Concrete Plan	Not required, no use of precast concrete.	Not applicable
Lift Slab Plan	Not required, no slab lifting activities are required for this PWS.	Not applicable
Masonry Bracing Plan	Not required, no masonry activities are required for this PWS.	Not applicable
Steel Erection Plan	Not required, no steel erection activities are required for this PWS.	Not applicable

Table 9-1 Summary of EM 385-1-1 Plan Evaluation

Plans Per Appendix A of EM 385-1-1 (November 2014)	Rationale for Inclusion or Exclusion	Location if Included
Explosives Site Plan	Per Section 01.G.C of EM 385-1-1, work performed with operations dealing with military munitions will be completed in accordance with USACE EM 385-1-97.	Explosives Site Plan, Appendix G of the UFP QAPP
Blasting Plan	No rock blasting is required for this PWS.	Not applicable
Diving Operations Plan	Applicable	Appendix H
Safe Practices Manual for Diving Activities	Applicable	Appendix H
Emergency Management for Diving	Applicable	Appendix H
Tree Felling/Maintenance Program	No trees greater than 2 inches in diameter will be removed during brush clearing activities.	Not applicable
Aircraft/Airfield Construction and Phasing Plan Aircraft/Airfield Safety Plan Compliance Document	No aircraft/or airfield construction is being completed.	Not applicable
Site Safety and Health Plan	Applicable	Appendix E
Confined Space Entry Procedures Confined Space Program	Confined spaces are locations that, by design, satisfy the following definition: • Are large enough and so configured that an employee can bodily enter and perform work • Limited or restricted means for entry or exit; (limited entry by means of configuration, location, size, number, etc.) • Are not designed for continuous worker occupancy. No work will be conducted in any areas that satisfy the above definition.	Not applicable
1 - 25.A.01.a. Conditions: For excavations/trenches less than 5 feet (1.5 meters) in depth, an AHA is required; plan is optional. For excavations or trenches greater than 5 feet (1.5 meters) in depth, an AHA and plan are required. NOTES: GFCI = Ground fault circuit interrupter		

9.1 FATIGUE MANAGEMENT PLAN

A Fatigue Management Plan has been completed for the Iona Island FUDS site because it is anticipated that during the life of the project the following triggers for a Fatigue Management Plan may be met:

- Exceed 10 hours a day for more than 4 consecutive days
- Exceed 50 hours in a 7-day work week
- Exceed 12 hours a day for more than 3 consecutive days
- Exceed 58 hours a week for sedentary (to include office) work.

Fatigue can be defined as a state of impairment that can include physical and/or mental elements. This is associated with lower alertness and ultimately reduced performance. Fatigue is the result of insufficient rest and sleep between activities and symptoms are not easily recognized. Rest is defined as a period of time during which the person concerned is off duty; is not performing work, including administrative tasks; and is afforded the opportunity for uninterrupted sleep. This does not include time for breaks, meals, or travel time to/from work.

Due to the inherent risks associated with munitions response activities, personnel performing munitions response activities that present an explosive risk shall be limited to a 50-hour workweek, with no individual workday exceeding 10 hours total, unless specifically authorized by the USACE COR.

9.1.1 Scope

Primary work tasks have been noted that would require fatigue management control include:

- Mobilization/demobilization
- Brush clearing
- Geophysical surveys
- Intrusive investigations
- Drilling
- Soil, groundwater, and sediment sampling.

9.1.2 Application

All employees are subject to fatigue; however, equipment operators and motor vehicle operators are the primary focus because of the use of equipment or vehicles that can put others in harm's way. A minimum of 8 consecutive hours of rest between shifts in a 24-hour period is required for equipment and motor vehicle operators. Equipment operators are defined as operators of equipment, including but not limited to the following, which may be found onsite: hosting equipment and draglines, mobile construction equipment, electrical power systems, and hydraulically operated equipment. These operators are not permitted to exceed 12 hours of duty time in any 24-hour period, including time worked at another occupation.

Motor vehicle operators are defined as operators of motor vehicles, while on duty. These operators shall not operate vehicles for a continuous period of more than 10 hours in any 24-hour period; no employee, while on duty, may operate a motor vehicle after being in a duty status for more than 12 hours during any 24-hour period.

9.1.3 Evaluation of Risk

There are several activities associated with the RI tasks (**Table 2-1**). Field crews tend to work long days and the work associated with the geophysical investigation process and the mobilization and demobilization process is physically and mentally demanding. Days associated with field activities are potentially anticipated to exceed the hour limitations described above.

9.1.4 Controls

Controls for fatigue may include work scheduling (limit number of consecutive shifts), rotating jobs to prevent repetitive work, breaks at critical times in the work cycle, control of environmental factors (heat, cold, and use of PPE), buddy check-in for individuals working alone, and alternate transportation for long commutes.

Two types of fatigue controls can be used: administrative controls and workplace controls.

Administrative Controls

- Alternate work tasks
- Allow for more frequent or longer breaks
- Alternative commutes
- Healthy food (lower sugar)
- Administrative employees take a walk
- Alternating, limit, or eliminating night shifts
- Schedule high risk tasks when most alert.

Workplace Controls

- Lifting devices
- Work assistance in lifting and holding
- Good ventilation
- Ability to move around every hour or so
- Use of PPE
- Alarms or monitors.

9.1.5 Training

Training shall include symptoms of fatigue, habits, and actions the worker may take to avoid fatigue, actions workers should take if they observe fatigue in a co-worker, and controls in place to prevent fatigue. This training will be integrated into the safety kickoff and periodically throughout the life of the project in daily tailgate safety meetings.

9.1.6 Procedures

The following procedures will be utilized for work tasks identified as having a risk of fatigue:

- Work tasks will be planned to eliminate or minimize fatigue, including utilizing the controls discussed in Section 9.1.4.

- Workers will be provided with adequate breaks.

- Workers will be encouraged to arrive to work in a rested state (ideally 8 hours of sleep, at least 5 hours of uninterrupted sleep).

- Symptoms of fatigue and work hours for equipment and vehicle operators will be monitored by employees and the SSHO/UXOSO. Symptoms include excessive yawning, reduced alertness, and reduced reaction time.

If a fatigued employee is identified, their task will be re-assigned to a non-fatigued employee. The fatigued employee will be safely transported (vehicle operated by other) to an area for rest.

9.2 EMERGENCY PLANS

An emergency is defined as a situation that requires calling outside help onto a job site. Depending on the phase of work, field personnel will immediately stop work and report to the Field Manager, SSHO, SUXOS, or UXOSO under the following situations: medical emergency, fire emergency, spill emergency, discovery of unanticipated hazards (e.g., drums, heavily contaminated materials), heavy equipment accident, overexposure of personnel to onsite contaminants requiring Emergency Medical Services, or heat/cold-related injury or stress requiring Emergency Medical Services support and diving accidents requiring hypobaric chamber treatment.

9.2.1 Procedures and Tests

Prior to work startup, personnel will be familiar with this Emergency Response Plan. A test of cellular phone coverage will be made across the entire work area and will be conducted prior to mobilization to ensure that emergency services can be alerted in the event of an emergency. For marine operations, radios will be tested prior to mobilization.

Prior to the start of work on land at the site, field personnel will conduct a drill to mobilize to a rally point designated by the SSHO/UXOSO for each work area. Alternate rally point locations will be communicated to field personnel. Additionally, the SSHO/UXOSO will review the provisions of this plan during the pre-entry site briefing. The Field Manager and/or the SSHO/UXOSO will make this plan available for review and photocopying. Emergency contact numbers are provided in **Table 9-2**. Directions to the nearest hospital (**Figure 9-1**) will be kept in vehicles onsite. If a diving emergency requires a hyperbaric chamber, 911 will route the appropriate transport to the site for transport. The closest emergency hyperbaric treatment center is the Jacobi Medical Center Hyperbarics located in the Bronx, New York.

In the event of an emergency, the information available at that time will be properly evaluated and the appropriate steps taken to implement the Emergency Response Procedures. The SSHO (or Field Data Manager/Site Supervisor if the SSHO/UXOSO is part of the emergency) will assume command of the situation, will call the appropriate emergency services, and will evacuate personnel to the rally point. Onsite emergencies will ultimately be handled by offsite emergency support personnel (i.e., the local fire department, ambulance squad, or police, depending on the nature of the emergency), who will have authority once they arrive. Information garnered onsite will not be released to parties other than those listed in this section and emergency responders.

After emergency response agencies have been notified, the Project Manager will then be notified immediately.

9.2.2 Posting of Emergency Telephone Numbers

Emergency telephone numbers will be kept in support vehicles. Additional copies will be distributed to site personnel by the SSHO/UXOSO. The SSHO/UXOSO will have the phone numbers readily available on his/her person or in their vehicle. Emergency contact information is presented in **Table 9-2**.

9.2.3 Spill Emergency Response Plan

Small incidental spills of non-hazardous materials less than reportable quantities (e.g., fuel in equipment) that do not cause injury to personnel or the environment are possible and will be cleaned up as quickly as possible. Waste will be containerized and disposed of properly and labeled accordingly. Spill kits will be present onsite in the event of spillage of fluids from site vehicles or during refueling of site vehicles during daily operations. Safety data sheets (SDSs) (**Appendix F**) will be reviewed prior to addressing the spill. This written plan applies to all employees. No testing of the recovered materials will be required based on the lack of a hazard. No escape routes or procedures will be required nor will critical plant operations (and the related emergency evacuation) be required. No rescue or medical duties are required beyond first aid/CPR training (and associated bloodborne pathogen training) that is already required for other site tasks.

Based on a review of the proposed phases of work at the Iona Island FUDS by the SHM, emergency response for spills will be conducted by outside emergency responders. No emergency response for spills will be handled by site personnel and emergency response for spills is not part of this PWS. No large quantities of materials will be handled.

9.2.4 Firefighting Plan/Fire Emergency Response Plan

Site personnel will not attempt to handle a fire/explosion emergency. The SSHO/UXOSO will take measures to reduce injury and illness, primarily by evacuating personnel as quickly as possible. The Field Manager may assist in this role. The Field Manager will then notify the Project Manager. Site personnel will evacuate the area and gather/meet at the rally point. The SSHO/UXOSO will be responsible for identifying if any site personnel did not gather at the rally point.

The Firefighting Plan will be presented by the SSHO/UXOSO and reviewed by site workers as part of the pre-entry site briefing (Section 6). In addition, the Director of Safety and Health, EA's designated authority for fire prevention and emergency response, prepares the fire hazard evaluation program that is reviewed by EA employees during annual employee safety and occupational health training.

As part of the Firefighting Plan/Fire Emergency Response Plan, the SHM will evaluate the operations and type(s) of equipment/materials to determine potential fire or explosion hazards and will convey this information to site personnel through the SSHO/UXOSO. Training requirements are listed in **Table 6-1**. A fire and/or explosion will be immediately recognized as an emergency. Emergency services (fire, police, and ambulance) will immediately be notified by the SSHO/UXOSO (emergency numbers are included in **Table 9-2**). A copy of the emergency numbers will be included in the site support vehicle.

Cleanup after such events may require specialized services and are not covered by this APP/SSHP. The Project Manager will establish proper cleanup actions through coordination with the Field Manager, emergency services personnel, with input from the USACE Project Manager. Emergency contact information is presented in **Table 9-2**.

9.3 PLAN FOR PREVENTION OF ALCOHOL AND DRUG ABUSE

Employees are strictly prohibited from any activity related to using, possessing, manufacturing, selling, transporting, distributing, storing, concealing, and/or dispensing any controlled or illegal substances, as defined by federal or state law, on the premises of EA, while conducting EA business (including travel), during EA-sponsored activities, or in off-the-job activities. This includes places of public accommodation or recreation, restaurants, and common carriers. Violation of this policy will result in immediate removal from the site and appropriate disciplinary action, up to and including termination of employment. If the employee is observed by another employee as not “fit-for-work” for any reason, contact the employee’s immediate Supervisor or Corporate Human Resources as the situation will be managed as any other performance problem. EA may drug test/screen employees at any time. Drug testing procedures are part of corporate policy and are not covered within this plan. Additionally, EA employees are to have no expectation of privacy with respect to any property brought onto site premises or carried during travel, including air travel. Specific information can be obtained from Corporate Human Resources. No part of this plan grants employees contract rights or changes their status as “at-will” employees.

9.4 SITE SANITATION/HOUSEKEEPING PLAN

***Housekeeping*—**Work areas will be kept clear of debris, tools, or other potential tripping hazards.

***Drinking Water*—**Adequate bottled drinking water will be provided to all site workers and will be stored in coolers within dedicated site vehicles; it will be cooled as necessary depending on weather conditions.

***Non-Potable Water*—**Water for decontamination activities will be obtained offsite.

***Toilets*—**Portable restroom facilities will be staged onsite.

***Washing Facilities*—**Employees will use handwashing in portable restroom facilities. Each vehicle will also be furnished with a bottle of hand sanitizer and an eyewash container.

***Showers and Food Service*—**Shower facilities, changing rooms, and clothes drying facilities are not necessary for this PWS. No food service will be provided at the Iona Island FUDS.

Waste Disposal—All municipal wastes (trash, dunnage, etc.) will be removed from the site in a timely manner from adequately located waste receptacles to prevent a health hazard.

9.5 MEDICAL SUPPORT AGREEMENT

Less than 100 personnel will be required onsite to complete this job; therefore, onsite medical support is not required for this project. At least two people currently trained in first aid/CPR will be present onsite. Training requirements are presented in Section 6. Offsite medical support will be provided by professional medical services presented in **Table 9-2**. The nearest hospital is New York Presbyterian Hudson Valley Hospital for emergency treatment.

Medical facilities identified in **Table 9-2** have been contacted to confirm that injured employees will be able to receive prompt treatment. No work tasks with a high or extremely high RAC on the AHAs have been identified; therefore, arrangements do not need to be confirmed in writing.

9.6 SITE-SPECIFIC BLOODBORNE PATHOGEN AND EXPOSURE CONTROL PLAN

This site-specific plan will be applied in conjunction with the EA Corporate Bloodborne Pathogen Exposure Control Plan and OSHA 29 CFR 1910.1030, which will be available for consultation by site employees when necessary. This plan applies to personnel who will potentially be providing first aid/CPR, as the completion of the work required in the PWS will not expose site personnel to bloodborne pathogens. OSHA definitions relating to bloodborne pathogens are covered during training.

Based on a review of the work required in the PWS for the Iona Island FUDS, only site personnel providing first aid/CPR will potentially be exposed to bloodborne pathogens. Universal precautions and PPE will be used by providers of first aid/CPR to prevent contact with blood or other potentially infectious materials when working with employees who have an injury or in areas where the injury may have contaminated surfaces. PPE required for the program is presented in Section 5 of the SSHP (**Appendix E**). No decontamination of PPE will occur; all PPE will be disposed of. Work areas will be kept clean and sanitary and will be decontaminated after contact with blood or potentially infectious materials with a dilute bleach solution. Information pertaining to the Hepatitis B Vaccination series; post-exposure reporting, evaluation, and follow-up procedures; and recordkeeping practices and requirements are presented in the EA Corporate Bloodborne Pathogen Exposure Control Plan, which is present online. Training requirements are presented in Section 6.

9.7 AUTOMATIC EXTERNAL DEFIBRILATOR PROGRAM

An AED will be located on board the boat during diving activities. It will be maintained onsite by the SSHO/UXOSO and will reside on the vessel. At least two onsite personnel will be trained in AED use. Trained personnel will familiarize themselves with the specific AED model and instructions prior to mobilization to the site. The SSHO/UXOSO shall conduct a weekly battery and functionality check and document the findings in that days' daily report. The Standard Operating Procedure for the AED is included in **Appendix D**.

9.8 SITE LAYOUT PLANS

No temporary construction ramps, trestles, scaffolds, or platforms will be placed onsite. Fencing is referenced in Section 9.8.3. **Figure 9-2** shows the location of the laydown area that is to include the placement of elements included below. Placement of these structures will occur during the mobilization phase of work. A site layout map will be used by the SSHO/UXOSO during the Tailgate Safety Briefing to inform the workers of the location of hazardous areas on the site, restroom facilities (including hand wash facility), assembly areas to be used in the event of site evacuation, and any other information relevant to the day's activities.

9.8.1 Temporary Construction Buildings

A temporary storage box or storage trailer may likely be placed at the site. The location of the storage will be coordinated with PIPC. The location will need to be approved by the PIPC at the time of site mobilization.

9.8.2 Facilities

Portable restroom facilities and a storage container will be placed onsite.

9.8.3 Fencing

No temporary fencing will be required.

9.8.4 Access Routes

Access to the land portions of the Iona Island FUDS project site will be via an unnamed road accessed from Route 9W. Access during emergency situations is identical to the access described above. When personnel are required to cross active railroad tracks located in the project area (it should be noted that there is no physical barriers or warning for approaching trains), personnel will stop, listen, look both ways, and if clear then pull across. The SSHO will include discussion the protocol for crossing active railroad tracks at the initial site briefing and as needed in daily briefings.

9.8.5 Anchor Systems for Temporary Structures

No temporary structures will be utilized.

9.8.6 Temporary Facility Spacing

No other temporary facilities other than the storage container and temporary restrooms will be placed with approval of PIPC; therefore, no spacing considerations are required.

9.8.7 Temporary Power Distribution Approval

No temporary power will be required.

9.8.8 Temporary Ramp, Trestle, Scaffold, and Platform Approval

No ramps, trestles, scaffolds, or platforms will be used to complete this scope of work.

9.9 HEARING CONSERVATION PROGRAM

EA will evaluate the workplace for noise hazards initially and regularly during the course of work. The hearing conservation program applies to all employees who are exposed to hazardous noise or ototoxic chemicals during work tasks described in Table 2-1. No ototoxic chemicals (including arsenic, carbon disulfide, carbon monoxide, cyanide, lead and derivatives, manganese, mercury and derivatives, n-hexane, Stoddard solvent, styrene, trichloroethylene, toluene, and xylenes) will be encountered during work tasks.

Workers will be made aware of potential noise hazards prior to the start of tasks with noise hazards. Medical surveillance (Section 6 of the SSHP [Appendix E]) includes pre-employment and end-of-employment testing.

9.9.1 Noise Hazard Identification

Noise measurements shall be made whenever there is difficulty in communicating at distances greater than 2 ft (0.6 meters) without site personnel raising voice levels, upon worker complaint of excessive noise, or whenever hazardous noise levels are suspected. Noise assessments and/or measurements shall be performed and documented when any new facility or new equipment is placed in service and when areas that in the past were not noise hazardous become noise hazardous for any reason.

9.9.2 Assessment of Noise Hazards

Workplaces known or suspected to include hazardous noise will be surveyed initially, annually, and whenever site conditions change impacting noise generation.

The following will be utilized for the assessment of noise hazards:

- For continuous (steady state) noise and impact (impulse) noise, the instrument settings shall be in accordance with **Table 9-3**.
- Dosimeters shall measure the entire employee’s work shift to be considered full-shift sampling.
- Calibration of noise measuring equipment shall be in accordance with manufacturer’s instructions (USACE refer to Engineer Regulation 385-1-89).

9.9.3 Exposure Standards

Work using heavy equipment often creates excessive noise. Noise can cause workers to be startled, annoyed, or distracted; it can cause physical damage to the ear, pain, and temporary and/or permanent hearing loss; and it can interfere with communication. For impact (impulse) noise, personnel exposures may not exceed 140 dBA (unweighted) without effective hearing protection devices.

If workers are subjected to noise exceeding an 8-hour time-weighted average sound level of 85 dBA (decibels on the A-weighted scale), hearing protection will be provided with an appropriate noise reduction rating to comply with 29 CFR 1910.95 and reduce noise levels to or below 85 dBA. Workers involved in drilling or heavy machinery operation activities are likely to be subjected to noise exceeding sound levels of 85 dBA peak sound pressure. At this level, hearing protection will be selected by the SSHO with an appropriate Noise Reduction Rating to reduce noise levels to or below these values (**Table 9-4**).

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, the combined effects must be considered.

Exposure to different levels for various periods of time shall be computed according to the following formula:

$$Cn = T1 / L1 + T2 / L2 + . . . + Tx / Lx$$

Where:

- Cn = Combined noise exposure factor.
- T = Total time of exposure at a specified sound-pressure level (in hours).
- L = Total time of exposure permitted at that level (in hours), from **Tables 9-3** or **9-4**, as appropriate If the sum exceeds 1, the mixture of exposure periods exceeds the threshold limit value (TLV).

9.9.4 Noise Controls

Hearing protection will be worn when working within 25 ft of heavy equipment that is in operation.

9.10 RESPIRATORY PROTECTION PLAN

The SHM is the Respiratory Program Administrator and has reviewed project tasks to prepare the respiratory protection plan for the site. This plan applies to EA employees and subcontractors who wear respirators on the job at the site.

Improper use of respirators can be hazardous to the employee's safety and health. Selection of the wrong equipment may result in the employee being unknowingly exposed to the hazard and thus inhaling harmful concentrations. Respirators that are not properly maintained, inspected, and cleaned can reduce the protection afforded, as well as cause skin irritation and place a greater strain on the respiratory system. An improper respiratory protection program may give the employee a false sense of security that could lead to harmful exposures. The purpose of this plan is to ensure that employees who must wear respirators are adequately protected and that respirator usage complies with the requirements of the OSHA Respiratory Protection Standard (29 CFR 1910.134).

EA will ensure appropriate respiratory protection of site workers. This plan describes the anticipated respiratory hazard, the feasible engineering, and work practice controls to reduce the hazard, the monitoring to measure the hazard, the correct respirator for each job, action levels for upgrading or downgrading respiratory protection, and personnel authorized to perform each task requiring respiratory protection.

9.10.1 Methods Used to Identify and Evaluate Workplace Respiratory Hazards

Respiratory hazards have been identified by reviewing site history to identify potential contaminants and their transport mechanisms and the proposed work tasks to be conducted. Individual potential volatile organic compound contaminants of concern have not been identified.

Based on the potential for site contaminants, respiratory protection may be required for volatiles. Prior to requiring upgrades in PPE, engineering controls (i.e., ventilation) will be employed to reduce exposure below the action levels presented in the SSHP (Appendix E). If engineering controls do not suffice, upgrades in PPE to include respiratory protection will be made. The environmental monitoring requirements, action levels, and potential PPE upgrades are presented in the SSHP (Appendix E).

9.10.2 Selection and Assignment

Based on the contaminants at the project site and reasonably expected potential concentrations in site media, a full-face air purifying respirator (APR) (North or MSA models) with combination high efficiency particulate air **(**HEPA)/organic vapor cartridges will provide adequate protection, if respirators are necessary. If an employee/subcontractor cannot be successfully fit tested with these respirator models, an alternate respirator model will be selected that provides a proper fit. Only respirators that are certified by the National Institute for Occupational Safety and Health will be utilized. Components of a respirator system will not be mixed or replaced with parts from different manufacturers. Alternate respirator models will be approved, prior to use in the field, by the SHM.

Oxygen deficient atmospheres will not be entered under this plan. Full-face APRs will not be permitted when atmospheric contaminants exceed the TLV (or in the absence of a TLV, the OSHA permissible exposure limit) (the more stringent value) by a factor of 10 if qualitative fit testing has been performed or 50 if quantitative fit testing has been performed (the protective factor for a full facepiece APR).

APRs will not be selected for protection against substances that lack adequate warning properties, unless the service life of the cartridge is specified, and field concentrations do not exceed specified amounts or the cartridge/canister has an end-of-service life indicator.

No site worker will be assigned a respirator unless the SSHO has determined that the employee is authorized to wear a respirator by virtue of current training and medical certificates.
Supplied air respirators are not included in the respiratory protection.

9.10.3 Fit Testing

At a minimum, qualitative fit testing using irritant smoke must be conducted annually on all individuals who will wear an APR. Such qualitative fit tests must follow the procedures outlined in Appendix A to 29 CFR 1910.134: Fit Testing Procedures (Mandatory) published in the *Federal Register* 8 January 1998. These procedures are provided in Appendix D and will be posted in the project trailer/office. Fit testing will be conducted by the SSHO or SHM. A fit test certificate will be issued upon successful completion and will include the respirator size and type, manufacturer name, and the signatures of the person performing the fit test and the person fit tested. Personnel are authorized to wear only those respirators for which they have been successfully fit tested.

9.10.4 Proper Use

Field personnel will wear only the respirator makes and models for which they have received hands-on respirator training or retraining (for APRs), within 12 months prior to use. In addition, for APR usage, a fit test with the specific make and model must have been successfully completed and documented within 12 months prior to use. Respirators will not be worn when conditions prevent a good face-to-facepiece seal. Such conditions may include but are not limited to:

- Growth of beard or sideburns, or a skull cap, hat, or other headgear that projects under the facepiece
- Absence of one or both dentures, or facial scars/deformities that affect the fit of the facepiece
- Corrective glasses or temple bars extend through the sealing edge of full facepiece.

As part of the donning procedure, the wearer will perform positive and negative pressure checks on the face-to-facepiece seal. If these fit checks indicate a possible leak, the user will re-adjust the facepiece and re-check. If the re-adjustment fails to correct the fit problem, the wearer will report this problem to the SSHO, who will either issue another respirator or perform fit testing using the qualitative fit test procedure, until a satisfactory fit is obtained.

If ambient temperatures are at or below freezing, a nose cup will be worn when full-face respirators are used.

Employees will return to a safe area to replace APR cartridges whenever breathing resistance increases or chemical breakthrough is detected or to wash their faces and respirators as necessary in order to prevent skin irritation. At the end of the workday, respirators will be cleaned, as specified in Section 9.9.5.

Basic rules for respirator usage are listed below:

- Facial hair that interferes with a satisfactory fit of the mask-to-face seal is not allowed on personnel required to wear respirators.

- Respirator cartridges should be replaced prior to reaching the service life, or after a full shift of continuous or intermittent usage, whichever is sooner. Cartridges should also be replaced if they become damaged, after the expiration date is exceeded, if vapor odor breakthrough occurs, or if filters become clogged causing resistance to breathing.

- Contact lenses may be worn when respiratory protection is required.

- Prior to donning, respirators will be inspected for worn or deteriorated parts.

- After donning, personnel will perform positive and negative pressure fit checks to determine if a good seal has been achieved.

- Site workers will be familiar with all sections of this Plan.

Used respirator cartridges will be managed and disposed as IDW, in accordance with the protocols specified in the Work Plan.

9.10.5 Maintenance, Inspection, Cleaning, and Storage of Respirators

Respiratory protection equipment will be properly inspected, cleaned, maintained, and stored to retain its original effectiveness. All persons who are assigned a respirator will be personally responsible for regularly cleaning, disinfecting, inspecting, and storing their assigned respirators as required by this section. The SSHO will be responsible for inspecting, storing, and distributing the respirators kept in the office supply.

Inspection by Wearer—Respirator wearers will inspect their respirators for defects **before and after each use** as delineated in the written inspection procedures that accompanied their respirator upon assignment. Defective or ill-fitting respirators will not be used and will be returned to the

SSHO immediately for replacement or repair. Personnel who cannot obtain an adequate fit check will inform the SSHO and be fit tested. Respirators that are not adequately clean will be returned to the most recent wearer who is responsible for cleaning and disinfecting the respirator according to the manufacturer's instructions.

Inspection by SSHO—On a daily basis, the SSHO will inspect the inventory of cartridges to ensure an adequate supply. On a weekly basis, the SSHO will inspect individually assigned respirators according to the inspection procedures provided by the respective respirator manufacturer. The SSHO will keep records of these inspections and note findings. The SSHO will also check the cleanliness of the respirators. Personnel whose respirators have not been maintained in good working order will be reported to their supervisor, who will issue appropriate disciplinary action.

Repair—Replacement or repair of respirators will be conducted only by the manufacturer's representative or SSHO with parts designed for the respirator according to the manufacturer's instructions. No attempt will be made to replace components or to make adjustment or repairs beyond the manufacturer's recommendations. All replacement parts must be identical to the original parts in order to maintain the National Institute for Occupational Safety and Health certification.

Cleaning and Disinfecting—After each use, respirators will be cleaned by the wearer according to these minimum cleaning requirements:

Wash with soap and water or respirator wipes or wipe with materials recommended by the respirator manufacturer. Place the facepiece (when dry) in a plastic bag and seal it.

Respirators will not be transferred from one employee to another until the most recent wearer has cleaned and disinfected it according to the manufacturer's instructions.

Storage—After inspection, cleaning, and necessary repair, the wearer(s) will store respirators in labeled plastic bags and protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Cleaned respirators will be stored at the onsite project trailer/office. Prior to storage in lockers, cabinets, desks, or other location, the wearer must place the bagged respirator in a clean storage carton, packing it so that the facepiece rests in a normal position and is not distorted. APRs will not be stored for prolonged periods with cartridges attached. If cartridges are reused, then the used cartridges will be placed in a separate sealable bag (labeled with the user's name) and stored with the user's bagged respirator.

APR Cartridges—Cartridges with marred, torn, or missing labels will be crushed and discarded without using. Transfer of used cartridges between personnel is not permitted. After use, APR cartridges will be discarded by the wearer.

9.10.6 Training

Personnel must be trained in proper use and limitations of respirators according to the requirements of this section. Prior to wearing respirators, field personnel will receive training from the SSHO that will include at a minimum:

- Overview of the requirements in the Respiratory Protection Plan
- Responsibilities of individuals involved in the plan
- Nature, extent, and effects of respiratory hazards to which the employee may be exposed
- Operation, limitations, and capabilities of the respirators selected
- Proper inspection, maintenance, care, and storage of respirators
- Procedures for respiratory failure or emergency situations
- Demonstrations and hands-on training in how to wear, fit, and adjust respirators and how to test the face-to-facepiece seal to determine proper fit
- Fit testing.

Pre-Use Briefing—If more than 12 months have passed since the employees received training or have worn respirators, or upon request of the employee, a "hands-on" pre-use briefing will be provided by the SSHO. This briefing will cover the safe and proper use of respirators.

9.10.7 Medical Requirements

Personnel will not be assigned to tasks requiring the use of respirators unless it has first been medically determined that they are physically able to perform the work and use the equipment. The medical exam will be performed by a licensed physician, and will include, at a minimum, completion of the OSHA Respiratory Medical Evaluation Questionnaire (Appendix C of 29 CFR 1910.134). Upon receipt of a satisfactory assessment signed by the examining physician, an EA employee or subcontractor may participate in respirator fit testing. No EA employee or subcontractor will wear a respirator in a hazardous atmosphere until the SSHO has received a final assessment signed by the licensed physician. Any limitations or restrictions noted by the physician will be observed. Respirator users must renew their medical certification annually.

Voluntary use of respirators, when respirators are not required, will meet the requirements of 29 CFR 1910.134, Appendix D.

9.10.8 Recordkeeping and Program Evaluation

Training certificates, as well as respirator fit test records will be stored by the SSHO for the duration of employment, plus 1 year in project files. Medical certificates and records for all project personnel must be stored for the duration of employment plus 30 years in project specific files.

Monitoring results will be permanently recorded. Monitoring results are posted or distributed to affected employees within 5 working days of receipt. Respirator inspection records will be kept by the SSHO on the job site and for 1 year (for APRs) in project files.

The SSHO will monitor the effectiveness of this respirator program by maintaining frequent communications with respirator wearers and conducting periodic inspections of the respirators. Problems identified will be resolved by the SSHO with assistance from the SHM, as needed.

9.10.9 Responsibilities

Project Manager

- Provide adequate resources for respiratory protection.

Safety and Health Manager

- Inform the Site Manager, UXOSO, and SSHO of those operations for which respiratory protection will be required, including emergency situations.
- In conjunction with the SSHO, and/or UXOSO, determine whether engineering controls or administrative controls can be used to limit the hazard to workers involved.
- Implement this respiratory plan whenever site workers may be exposed to a respiratory hazard.

SSHO/UXOSO

- Provide onsite training for this respiratory protection plan.
- Maintain, distribute, and store respiratory protection equipment, including cartridges for air purifying respirators.
- Ensure that authorized personnel appropriately wear the assigned respiratory protection.
- Inform potentially affected employees about this plan.
- Conduct periodic inspections of respiratory protection equipment.

- Issue respirators and associated equipment to authorized site workers.
- Perform respirator fit tests, as needed.
- Ensure that subcontractors to EA who must wear respiratory protection submit evidence of medical approval for respirator usage and training in respirator usage including a fit test, within the prior 12 months, and are apprised of the respiratory protection requirements outlined in this plan.
- Conduct frequent, random inspections of workers' respiratory protection during work operations.

EA and Subcontractor Personnel

- Only authorized EA and subcontractor personnel will wear respirators. Authorized personnel have successfully completed an initial training course in respirator usage, are annually re-trained, and are medically certified for respirator usage annually. All personnel who wear respirators will be fit tested annually.
- Non-authorized EA and subcontractor employees will not wear respirators and will not be exposed to potentially hazardous atmospheres. If a non-authorized employee suspects that an atmosphere is unsafe, the employee will leave the area and immediately report to his/her supervisor.
- Properly inspect, use, maintain, clean, and store assigned respiratory protection equipment in compliance with the requirements of this plan.
- Notify Supervisor immediately of any suspected safety/health hazards associated with the use of respiratory protection.
- Use respirators in accordance with manufacturer's instructions.
- Personnel must be clean-shaven wherever the respirator facepiece seals to the wearer's skin. Personnel may not have facial hair that impairs the function of the respirator.
- If glasses are required, personnel will wear a respirator spectacle kit whenever they wear a full-face respirator.
- Personnel will not alter or modify respirators in any way.
- Read the site-specific safety and health plan prior to undertaking any tasks which may require respiratory protection.

9.11 HEALTH HAZARD CONTROL PROGRAM

The presence of hazards will be assessed through identifying work phases and potential physical, chemical, biological, and radiological hazards associated with those work phases. Work phases for this site are listed in Section 2. The hazards and related controls, including engineering controls and PPE, for activities performed during these work phases were assessed by the SHM during development of this APP and are described in AHAs included in **Appendix A** and the SSHP (**Appendix E**). To understand potential hazards associated with each required activity, AHAs are reviewed with onsite personnel prior to performing site tasks.

9.12 HAZARD COMMUNICATION PROGRAM

The purpose of this Hazard Communication Program is to ensure that important information regarding hazardous chemicals used, handled, or stored during the conduct of business is transmitted to employees and other affected persons as appropriate. A hazardous chemical, as defined by OSHA, is any chemical that is either a physical hazard or health hazard and includes hazardous chemicals generated during work operations. Chemical hazard information will be made available to employees and other affected persons, as appropriate, through the implementation of this comprehensive program, which includes container labeling and other forms of warning, collection, and compilation of material safety data sheets (SDSs, and training. A summary of the hazard communication program, as it pertains to this PWS, is presented below.

9.12.1 Chemicals Included in the Hazard Communication Program

The program applies to hazardous chemicals that are known to be present in the workplace and used or stored in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency. It is the responsibility of the SHM with support of the SSHO/UXOSO to ensure that chemical materials meet the provisions of this Hazard Communication Program. If there are any questions regarding the applicability of these program requirements to a particular material or situation, the SHM will be consulted.

The following materials are exempt from requirements of the program:

- Hazardous waste as defined by Resource Conservation and Recovery Act when subject to regulations issued under the U.S. Environmental Protection Agency (USEPA)
- Hazardous substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) when subject to regulations issued under CERCLA by USEPA
- Tobacco or tobacco products
- Wood or wood products which will not be processed; wood treated with a hazardous chemical and wood which may be sawed or cut, generating dust, are covered

- Articles which are a manufactured item other than a fluid or particle; formed to a specific shape or design during manufacture; which have end use functions dependent in whole or in part upon their shape or design during end use; and which, under normal conditions or use, do not release more than minute or trace amounts of a hazardous chemical and do not pose a physical hazard or health risk to employees

- Any drug when it is in solid, final form for direct administration such as over-the-counter drugs and first aid supplies

- Cosmetics

- Any consumer product or hazardous substance, where it can be demonstrated that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended

- Nuisance particulate where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard

- Ionizing and non-ionizing radiation

- Biological hazards.

9.12.2 Lists of Hazardous Chemicals

The SHM has reviewed the list of chemicals required to complete the PWS at the Iona Island FUDS and determined that no hazardous chemicals will be used, brought onsite, or manufactured. Non-hazardous chemicals brought onsite are presented by the SDSs in **Appendix F**. The list of chemicals required to complete the PWS includes the name of each chemical, type of compound (e.g., flammable, corrosive, poison), the date of the inventory, and the location of the compound. The UXOSO/SSHO will maintain the list for the duration of the project, update the list appropriately, notify site personnel and the SHM of the addition of new compounds, and inform the site personnel of the associated hazards of those compounds. Small amounts of chemicals will be required for sample preservation. SDSs for all onsite chemicals, even non-hazardous chemicals, will be updated in a manner consistent with the above paragraph as new chemicals are brought onsite.

9.12.3 Labels and Other Forms of Warning

Site personnel will rely upon the original product labels to the extent practical. When labels must be applied to a temporary container, they will be printed in English and contain the following information:

- Identity of the hazardous chemical(s)

- Appropriate hazard warnings (i.e., any words, pictures, symbols, or combination thereof), which provide employees with specific information regarding the physical or health hazard(s) including primary target organ effect(s)

- Name of the chemical manufacturer, importer, or other responsible party, if appropriate.

Labels and other forms of warning will be legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. If existing labels already contain the required information, new labels are not required.

9.12.4 Alternatives to Labeling, Tagging, or Marking Requirements

Alternatives to the above-referenced labeling, tagging, or marking requirements are described below:

- Signs, placards, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the marking information required above. The written materials will be readily accessible to employees in their work area throughout each work shift. If this alternative system is utilized, it will be done only with approval of the SHM or the UXOSO/SSHO.

- Portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer, are not required to be labeled (e.g., fueling vehicles with gasoline).

9.12.5 Shipping Hazardous Chemicals

No shipping of hazardous chemicals is required for completion of this PWS. Decontamination methods (presented in Appendix E of the SSHP) will not generate hazardous chemicals.

9.12.6 Safety Data Sheets

The UXOSO/SSHO will maintain a copy of the SDS for each new chemical brought onsite and will ensure that they are readily accessible during each work shift to employees when they are in their work area(s). While conducting site-specific field operations, the list of chemicals and the SDSs must be readily available onsite. SDSs for insect repellant (DEET and Permethrin), diesel fuel, fire extinguisher, sunscreen, and gasoline are presented in **Appendix F** and will be maintained with the UXOSO/SSHO.

9.12.7 Employee Information and Training

At a minimum, training will be conducted at the pre-entry briefing and whenever a new physical or health hazard (e.g., new material brought onsite) the employees have not previously been trained in is introduced into their work scope.

9.13 FIRE PREVENTION AND PROTECTION PLAN

Fire hazards at the Iona Island FUDS associated exhaust from vehicles creating enough heat to ignite combustibles (grass) will be considered. Detonation of MEC can also cause fires. No fixed water supply is present at the Iona Island FUDS. Therefore, fire suppression equipment will consist of portable fire extinguishers. Site work has been conveyed to the local fire and police departments to brief responders prior to an emergency response. Based on a review of the hazards associated with this PWS, no unusual fire hazards exist other than MEC detonation for completion of this RI. Smoking is prohibited within 50 ft of sampling locations or vegetated areas and there are no areas with underground fire hazards. No compressed gas cylinders or Department of Transportation-identified incompatible materials are required for this RI. No brush-control, steel-cabinets, insulating materials, disposal of combustible materials, burning operations, use of low-density fiberboard, temporary enclosures, temporary building spacing requirements, or fire lanes are required. There are no hazardous locations onsite with respect to a fire prevention plan. No additional combustible materials are required to complete this RI; therefore, safety issues regarding lighting, flames of torches to cut/sweat pipe, use of formwork and scaffolding, and fire protection in the construction process are invalid (reference training [Section 6] and inspection [Section 7] requirements[2]).

[2] The inspection presented in Section 7 covers annual survey, suitability, and effectiveness requirements of this plan and the associated documentation.

Table 9-2 Emergency Contact Numbers

Contacts	Name	Office/Work	Mobile
Ambulance, Fire, and/or Police	Fort Montgomery Fire District	911/845-446-7116	Not applicable
Hospital (24 Hours)	New York Presbyterian Hudson Valley Hospital	914-737-9000	Not applicable
Hyperbaric Chamber	Jacobi Medical Center Hyperbarics	718-918-5800	Not applicable
USACE Project Manager	Erin Kirby, P.G., LEP	978-318-8147	Not applicable
USACE Technical Manager	Todd Beckwith	410-962-6784	Not applicable
USACE Ordnance and Explosives Safety Specialist	Marty Holmes	Not applicable	315-525-1195
EA Program Manager	Brenda Herman, P.G.	410-527-2474	410-913-1681
EA Corporate Safety and Health Director	Peter Garger, CIH, CSP	410-527-2425	410-790-6338
EA National Service Line Program Manager Munitions Response	Richard Hanoski	443-632-4887	443-632-4887
EA Project Manager	Timothy Reese, P.E.	410-329-5198	410-935-3887
EA Senior Geophysicist/Quality Control Geophysicist	Michael McGuire, P.G.	Not applicable	443-986-2488
EA SSHO	Eddie Meadows	410-671-6051	410-961-4028
SSHO Alternate	Jeff Smith	410-671-6051	410-627-4195
EA UXOSO	John Monk	410-584-7000	717-887-5582
EA UXOSO Alternate	Ward Stern	To Be Determined	256-731-9151
EA SUXOS	John “JD” Marlowe	443-752-1775	443-752-1775
AOR Project Manager	Brandon Puttroff	Not applicable	619-203-7325
AOR DPIC / Diving Supervisor	Steve Mulholland	Not applicable	619-559-5888
ANJV Senior Geophysicist	Alex Kostera	434-559-5888	434-559-5888
ANJV AGC Project Manager	Mark Howard	434-978-3187	434-978-3187
PIPC Executive Director	James Hall	845-786-2701	Not applicable
Poison Control	Not applicable	800-222-1222	Not applicable
U.S. Environmental Protection Agency National Response Center	Not applicable	800-424-8802	Not applicable
EA Medical Services (Physician)	All One Health Resources	800-350-4511	Not applicable
New York State Department of Health	Bureau of Occupational Health and Injury Prevention	(518) 402-7900	Not applicable
Federal OSHA Hotline	Not applicable	800-321-6742	Not applicable

Table 9-3 Settings for Noise Measuring Equipment

Feature	Dosimeter (ACGIH)	Dosimeter (Department of Defense and USACE)*	Type 2 (or better) Sound Level Meter for Continuous Noise (USACE)*	Type 1 Sound Level Meter for Impulse Noise (USACE)*
Criterion Time	8 hours	8 hours	8 hours	8 hours
Criterion Level	85 dBA	85 dBA	85 dBA	85 dBA
Weighting	A	A	A	Unweighted, linear, or Z
Peak Weighting	Unweighted	Unweighted, linear, or Z	Unweighted, linear, or Z	Unweighted, linear, or Z
Threshold Level	80 dBA	80 dBA	80 dBA	140 dBA
Upper bound on integration	130 dBA	None	None	None
Time Weighting	Slow	Slow	Slow	Impulse
Exchange Rate	5 dBA	3 dBA	3 dBA	3 dBA

* When used for the purposes of delineating noise hazardous areas or evaluating noise exposures to personnel.
NOTES:
ACGIH = American Conference of Governmental Industrial Hygienists

Table 9-4 Non-Department of Defense Continuous Noise Exposures

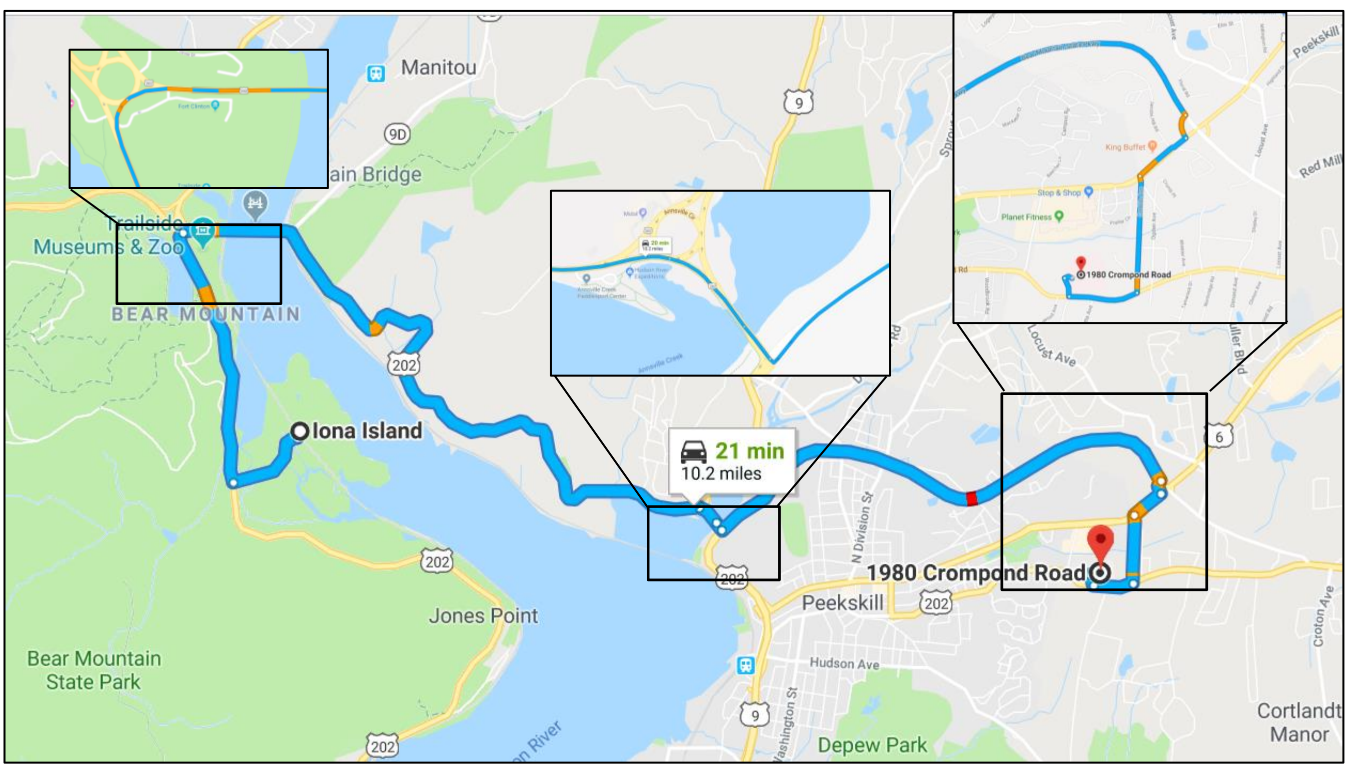
OSHA Standard Duration per day (hours)	Permissible Sound Pressure Level (dBA)
8	85
4	88
2	91
1	94
0.5 = 30 minutes	97
0.25 = 15 minutes	100

Figure 9-1 Hospital Map and Directions

Directions to the New York Presbyterian Hudson Valley Hospital from the Iona Island FUDS

- Distance to Nearest Hospital (with emergency room): 10.2 miles and 21 minutes
- Hospital Name: New York Presbyterian Hudson Valley Hospital (24 hours)
- Hospital Phone: (914) 737-9000
- Hospital Address: 1980 Crompond Road, Cortlandt, New York 10567
- Route to Hospital: Directions and map to hospital below:

  - Head west towards US 202/US 9W on the unnamed road (0.5 miles)
  - Turn RIGHT onto US-202 E, follow to Bear Mountain State Parkway/New York State Reference Route 987H in Peekskill (5.8 miles).
  - At the traffic circle, take the 1st exit onto US-202 E/US-6 E (4.2 miles).
  - At Annsville Circle, take the 1st exit onto US-202 E/US-6 E/U.S. 9 S/Jans Peeck Bridge (0.1 miles).
  - Keep LEFT to continue on Jans Peeck Bridge (272 feet).
  - Turn LEFT onto Bear Mountain State Parkway/New York State Reference Route 87H (signs for Bear Mountain Parkway/Taconic State Parkway) (2.9 miles).
  - Turn RIGHT onto US-6 W (0.2 miles).
  - Turn LEFT onto Conklin Avenue (0.8 miles)
  - Turn RIGHT onto Crompond Road/US 202 W (0.2 miles)
  - New York Presbyterian Hudson Valley Hospital is at 1980 Crompond Road on the RIGHT.



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\\lovetongis\GISdata\Federal\Northeast\NewYork\IonaIsland\MXD\MMRP_QAPP\Figure 9-2 Laydown Area.mxd

0 400 800
Feet

Legend

- Site Location
- FUDS Boundary
- Approximate Area of 1903 Explosion
- Shoreline Investigation Area
- Laydown Area
- Former Dock
- Former Causeway
- Underwater Investigation Area (Former Docks)
- Building DU
- 1 Acre Explosives Building DU
- DGM Grid (100ft x 100ft)

N

FIGURE 9-2
LAYDOWN AREA

IONA ISLAND NAVAL AMMUNITION DEPOT
Formerly Used Defense Site
ROCKLAND COUNTY, NY

Map Date: 09/21/2018
Projection: NAD 1883 State Plane
New York East FIPS 3101 (US Feet)

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10. RISK MANAGEMENT PROCESSES

An assessment of the hazards, training, and equipment required to perform the tasks were completed as part of a risk analysis by corporate health and safety management with input from personnel who have previously performed the tasks. In accordance with EM 385-1-1 01.A.14, major activities and phases of work to be performed will be covered in an AHA. AHAs will be reviewed with all personnel involved in a task prior to each work activity or phase presenting hazards not experienced in previous project operations.

Upon commencement and throughout the activity, the AHA will be used to verify compliance with the prescribed hazard controls and to note any potential changes in process. The AHAs provide detailed project-specific hazards and controls for each major phase/activity of work. The primary activities and phases of work required to complete the PWS for the Iona Island FUDS are presented in Section 2. AHAs are included in **Appendix A**.

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11. PERSONAL PROTECTIVE EQUIPMENT

Information pertaining to PPE is presented in the SSHP (**Appendix E**).

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12. REFERENCES

EA Engineering, Science, and Technology, Inc., PBC (EA). 2018. *Draft Uniform Federal Policy Quality Assurance Project Plan, Military Munitions Response Program Remedial Investigation at the Iona Island Naval Ammunition Depot Formerly Used Defense Site, Rockland County, New York*. October.

U.S. Army Corps of Engineers (USACE). 2014. *Engineering Manual 385-1-1 Safety and Health Requirements Manual*. 30 November.

USACE. 2008. *Engineering Manual 385-1-97 Explosives Safety and Health Requirements Manual*. 17 May.

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Appendix A

Activity Hazard Analyses

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ACTIVITY HAZARD ANALYSES

This appendix contains U.S. Army Corps of Engineers Activity Hazard Analysis (AHA) forms for the Military Munition Response Program (MMRP) and Hazardous Toxic and Radioactive Waste (HTRW) Remedial Investigation (RI) through Decision Document (DD) for the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS), Rockland County, New York Accident Prevention Plan (APP). Table 1 presents the phases of work listed in Section 2 of the APP and each corresponding AHA. Each AHA is presented in the order it will occur and will apply to all subsequent phases of work.

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Phases of Work and Site-Specific Activity Hazard Analyses

	MMRP RI Tasks										HTRW RI Tasks					
Site-Specific Activity Hazard Analysis [a]	**Mobilization and Demobilization**	**Land Survey**	**Brush Clearing**	**DGM Surveys**	**AGC Survey**	**Mag and Dig**	**Soil Sampling**	**Land-Based Intrusive Investigation**	**Underwater Surface and Investigation**	**Sediment Sampling**	**Mob. And Demobilization**	**Direct Push Soil Boring**	**Piezometer Installation**	**Ground-water Sampling**	**Sediment Sampling**	**Bedrock Well Installation**
General	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Large Hand Tools Use	X		X													X
Small Hand Tools Use	X			X	X					X			X	X		X
Intrusive Investigation of Target Anomalies								X	X							
MEC Avoidance		X	X	X	X		X	X		X		X	X		X	X
MEC Detector-Aided Surface/Subsurface Clearance		X	X	X	X	X		X								
MPPEH Inspection			X	X	X	X		X	X							
MEC Disposal			X	X	X	X		X	X							
Munitions Debris Inspection and Disposition			X	X	X	X		X	X							
Soil Sampling							X	X								
Surface Water/Sediment Sampling										X					X	
Groundwater Sampling/Well Development														X		
Direct Push Soil Boring/ Well Installation												X				X
Boating Operations									X							
Diving[a]									X							

[a] Included with the Dive Plan (Appendix H)

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ACTIVITY HAZARD ANALYSIS – GENERAL

Activity/Activities:	**General**	**Phases:** All	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	D. Wilt		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	SSHO, UXOSO, or Subcontractor(s)						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
General	Biological Hazards: Bites and stings from insects and spiders; contact with poisonous plants, snakes	Inspect work areas when arriving to identify biological hazard(s). Use insect repellant. Insect repellant containing DEET may be used on exposed skin and/or clothing. Insect repellant containing Permethrin may only be applied to clothing. Stay alert and a safe distance away from biological hazards. Use barrier cream and appropriate PPE, which includes steel or composite toe ankle length boots, safety glasses, hardhat, ANSI Class 2 vest and work pants that will prevent injury from biological hazards as discussed in Section 2.10 of the SSHP. Workers with allergies should carry antidote kits, if necessary. Antidote kits (e.g., epi-pens) will be declared to the SSHO and site personnel regarding where the pen is kept and instructions on how to use the pen. Workers will use snake chaps as appropriate in overgrown areas.	3/3/M
General	Physical Hazard: Slips, trips, and falls	When working throughout the site, keep work area free of excess material and debris. Keep non-essential personnel away from equipment and tools. Work at an appropriate pace and do not run. Remove all trip hazards by keeping materials/objects organized and out of walkways. Be aware of uneven surfaces while walking. Stay aware of footing and do not run.	3/3/M
General	Physical Hazard: Noise	Hearing protection shall be worn by personnel when working around (within 25 feet of) heavy equipment.	2/4/M
General	Physical Hazard: Back strain and other muscle injuries from manual lifting	Follow proper lifting techniques for all objects at the site including, but not limited to, equipment, erosion and sediment control materials, soil samples, hand tools, small hand tools, shovels, and/or digging equipment. Use caution and do not twist the back when carrying heavy objects. Do not attempt to lift bulky items or items assessed at over 50 pounds without assistance. If an item's exact weight is unknown, consult the SSHO and consider a team lift. Use mechanical devices to move loads when possible (i.e., a skid steer to move clearing equipment or debris versus carrying items). Work gloves must be worn when personnel are handling materials.	3/3/M
General	Physical Hazard: Heat and cold stress	Conduct temperature monitoring when temperatures fall below 45°F and are above 75°F. Appropriate cold-weather clothing will be worn when temperatures fall below the range stated above and shelter will be provided (vehicles/boat). Potable water will be made available and workers are required to drink small amounts frequently. Work/rest regiments will be adjusted in hot and cold weather in accordance with Tables 8-1 and 8-2 in the SSHP. Use the buddy system when working.	3/4/L

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
General	Physical Hazard: Striking an object or person while driving a support vehicle or operating heavy equipment	Obey all traffic laws, including no cell phone usage while driving. 15 miles per hour is the maximum speed allowed in the work area and seat belts must be worn. Maintain eye contact with site personnel walking around or in the vicinity of the vehicles. Do not operate vehicles in unsafe conditions (e.g., on steep slopes, in deep mud). Back into parking locations (or pull through) wherever possible; use spotters when backing up in congested areas. Be aware of obstacles to avoid or clear. Be aware of surrounding vehicles. Do not park or generally navigate in the blind spot of other vehicles or the brush-clearing equipment. If you are uncertain of the blind spot, maintain a distance of 25 feet from heavy equipment and coordinate with the operator. Use a spotter when working in the vicinity of personnel and equipment. Be aware of pinch points with machinery and vehicles, and keep body parts clear of pinch points.	3/3/M
General	Physical Hazard: Falling objects	Be aware of overhead hazards, including tree branches. Employees will wear Level D PPE.	3/3/M
General	Physical Hazard: Weather/extreme weather	Monitor weather conditions. Discontinue work during lightning and severe weather events and wait 30 minutes in project vehicles or trailer after last occurrence of lightning within 6 miles as based on a lightning detector/NOAA radio application/Lightning Strike Map. The SSHO is responsible for alerting the “all-clear” to resume work. If unfavorable weather conditions arise, the SSHO will evaluate the safety hazards and activities will be halted at the discretion of the SSHO.	3/3/M
General	Physical Hazard: Visibility	Personnel must wear a high-visibility traffic vest at all times.	3/3/M
General	Physical Hazard: MEC	Ensure exclusion zones are established to authorized minimum safe distances for non-project personnel and team separation distances for project personnel. Use the minimum number of personnel (not less than two) to conduct the operation and minimize their exposure time to MEC. Ensure all personnel are under the direction of DDESB-qualified UXO Technicians. Do not conduct operations within site-specific minimum safe distances of other MEC intrusive operations. Observe general MEC hazards and precautions. Ensure compliance with relevant SOPs and the MEC Explosives Site Plan.	2/3/M
Refueling	Physical Hazard: Fire	Wear Level D PPE and ensure emergency equipment (fire extinguishers) are appropriately placed. Eliminate ignition sources; keep all potential ignition sources at least 20 feet from the work area. Practice vapor awareness (e.g., gasoline flash point is -40°F; diesel fuel flash point is 135°F). Ensure nozzle is in contact with tank to eliminate potential static discharge. Avoiding static discharge when fueling. To minimize the chance of static discharge at the pump, you must ensure metal-to-metal “bonding” by using a metal bonding cable or keeping the nozzle in contact with the tank being filled. Avoid spilling fuel, and cleanup spills following the instructions on the spill kit. Practice good housekeeping and keep obstacles, debris, and refuse away from your work area.	2/3/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Insect repellant and/or barrier cream • Level D PPE (steel/composite toed boots, safety glasses, hardhat [when overhead hazards are present], work pants, blaze orange/yellow clothing and/or reflective safety vests, and work gloves) • Antidote kits (if applicable) • Emergency equipment including first aid kit and fire extinguishers • Lightning detector, NOAA application, or use of lightning strike map • Excavation equipment (during intrusive activities) • Support vehicles	• Inspect PPE prior to each use • Inspect emergency equipment/supplies monthly (first aid, fire extinguisher)	• Use and limitations of PPE • Valid driver’s license (if driving) • APP and AHA review

ACTIVITY HAZARD ANALYSIS – LARGE HAND TOOLS

Activity/Activities:	**Large Hand Tools**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	Site Safety and Health Officer (Doug Thompson) SSHO, UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (UXOQCS), UXOTIII, UXOTII, Field Technician						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Use of large hand tools with saw or blade	Physical Hazard: Laceration	Cover saw or blades with guard when not in use and during transport. Wear Level D PPE as described below. Never saw or cut alone; implement the buddy system. Hold shaft with one hand approximately 8-12 inches from head and other hand approximately 6 inches from top. Check the clearance in the area in which you are to swing with respect to the location of objects and personnel. Set feet in a balanced position with terrain. Set the tool on the object to be struck before beginning swing. Lift the tool in a controlled manner and swing toward object.	3/3/M
Use of large hand tools to remove small diameter trees	Physical Hazard: Injuries from falling trees and limbs	Notch all trees when possible/practical. Always cut trees from the uphill side. Tree area should be cleared of extra personnel once the tree has been notched. Maintain good communication with partners; be sure who will remove saw when felling. Use warning shouts when felling and maintain proper spacing. Watch for felled material rolling downhill.	3/3/M
Use of large hand tools	Physical Hazard: Back injuries or muscle strain	Hold shaft with one hand approximately 8-12 inches from head and other hand approximately 6 inches from top. Check the clearance in the area in which you are to swing with respect to the location of objects and personnel. Set feet in a balanced position with terrain. Set the tool on the object to be struck before beginning swing. Lift the tool in a controlled manner and swing toward object.	3/3/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Large hand tools • Level D PPE within the exclusion zone (steel/composite toed boots, safety glasses, hardhat, work pants, blaze orange/yellow clothing and/or reflective safety vests, work gloves)	• Inspect PPE prior to each use • Inspect large hand tools prior to use	• Use and limitations of PPE • APP and General AHA review

ACTIVITY HAZARD ANALYSIS – SMALL HAND TOOLS

Activity/Activities:	**Small Hand Tools**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom** / **5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H / M
			2 Critical	E	H	H	M / L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L / L
			4 Negligible	M	L	L	L / L
Competent and/or Qualified Person(s):	Site Safety and Health Officer (Doug Thompson) SSHO, UXO Safety Officer (UXOSO)/UXO Quality Control Specialist (UXOQCS), UXOTIII, UXOTII, Field Technician						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Use of small hand tools with sharp edges	Physical Hazard: Laceration	Cover saw or blades with guard when not in use and during transport. Wear Level D PPE as described below. Never saw or cut alone; implement the buddy system. Hold shaft with one hand approximately 8-12 inches from head and other hand approximately 6 inches from top. Check the clearance in the area in which you are to swing with respect to the location of objects and personnel. Set feet in a balanced position with terrain. Set the tool on the object to be struck before beginning swing. Lift the tool in a controlled manner and swing toward object.	3/3/M
Using hammer and screwdrivers	Physical Hazard: pinching, smashing	Wear eye protection Wear proper fitting gloves Clear area of other people	3/3/M
Tool Selection	Wrong Tool for the Job	Ask for help and advice Wear eye and hearing protection Wear proper fitting gloves Make sure safety devices on saws are operating Clear area of other people	3/3/M
Use of small hand tools	Physical Hazard: Back injuries or muscle strain	Hold shaft with one hand approximately 8-12 inches from head and other hand approximately 6 inches from top. Check the clearance in the area in which you are to swing with respect to the location of objects and personnel. Set feet in a balanced position with terrain. Set the tool on the object to be struck before beginning swing. Lift the tool in a controlled manner and swing toward object.	3/3/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Large hand tools • Level D PPE within the exclusion zone (steel/composite toed boots, safety glasses, hardhat, work pants, blaze orange/yellow clothing and/or reflective safety vests, work gloves)	• Inspect PPE prior to each use • Inspect large hand tools prior to use	• Use and limitations of PPE • APP and General AHA review

ACTIVITY HAZARD ANALYSIS – INTRUSIVE INVESTIGATION OF TARGET ANOMALIES

Activity/Activities:	**Intrusive Investigation of Target Anomalies**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**				**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**					
Project Number:	63029587			**Probability**				
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	UXOSO/UXOQCS, SUXOS and UXO Technician III							
Step 1: Review each "hazard" and determine RAC.							RAC Chart	
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.							E = Extremely High Risk	
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.							H = High Risk	
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.							M = Moderate Risk	
							L = Low Risk	

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Intrusive Investigation of Target Anomalies	Physical Hazard: MEC	Ensure Exclusion Zones (EZs) are established to authorized minimum safe distances (MSDs) for non-project personnel and team separation distances for project personnel. Use the minimum number of personnel (not less than two) to conduct the operation and minimize their exposure time to MEC. Ensure all personnel are under the direction of DDESB-qualified UXO Technicians. Do not conduct operations within site-specific MSDs of other MEC intrusive operations. Observe general MEC hazards and precautions. Ensure compliance with relevant SOPs and the MEC ESP.	2/4/M
	Physical Hazard: Hand-Digging Anomalies	Always use a two-man dig team Dig on the side of the anomaly so as not to strike the anomaly. Only excavate the anomaly to the extent needed to confirm the identity and hazard associated with the item.	2/4/M
	Physical Hazard: Manual Lifting	Follow proper lifting techniques. Use caution and do not twist the back when carrying a load. Do not attempt to lift bulky items or items assessed at over 50lbs. without assistance. Use mechanical devices to move loads when possible. Wear leather gloves for materials handling.	3/3/M
	Physical Hazard: Hand Tools	Inspect tools prior to use. Use tools for their intended use only. Don’t use damaged tools. Push, don’t pull wrenches.	3/3/M
	Physical Hazard: Underground Utilities	Complete utility locates and/or coordinate with site personnel. Mark any utility locations in white. Field verify utility locations. Document all utility locations. Observe the area for indication of utilities.	2/4/M

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
	Physical Hazard: Injury from heavy equipment	Be aware of the location of equipment, wear high visibility vest, and establish eye contact with operator. Be aware of pinch points, swinging chains, buckets, etc. Wear appropriate PPE (hard hat) when working in proximity to equipment and overhead hazards.	2/4/M
	Physical Hazard: Faulty or Inappropriate Equipment	Operator must inspect equipment prior to use, if faulty or inappropriate, do not proceed until repaired or replaced. Inspect all hand tools prior to use, if faulty or inappropriate, do not proceed until repaired or replaced.	2/4/M
	Physical Hazard: Moving Equipment	Clear area of obstructions and communicate with all workers involved that excavation is beginning. Secure loose clothing. Do not walk under suspended loads. When possible, remove overhead hazards promptly. Wear appropriate PPE including hard hat and steel-toed boots. Use spotters when moving in/out of nominal clearance areas. Backup alarms are required when equipment is backing up.	3/4/L
	Falls	The number of personnel on the ground in the vicinity of excavation activities shall be limited to those necessary for the job. Workers shall maintain eye contact with equipment operators. Select and implement the appropriate excavation perimeter protection as specified in US Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1, Section 25 B and Appendix Q). All excavations will be backfilled at the end of the workday if possible; otherwise, suitable barriers must be used to prevent unauthorized entry. Any excavation four feet and deeper will be provided with ladders, ramps or other means of egress in such a way as to require no more than 25 feet of lateral travel. They will also be used for ingress.	3/3/M
	Caught –In (excavation collapse)	Obtain Excavation/Trenching Permit as required by client, State, or municipality prior to any excavation activities. NO ENTRY is permitted into excavations/trenches without approval from the Competent Person. Authorization for entry shall only occur when a proper protective system is in place If a person must enter an excavation, protective systems such as trench boxes, shoring, sloping, or benching, will be effected in excavations greater than five feet in depth, or if deemed necessary by a Competent Person. The designated Competent Person shall be present during all excavation activities. Excavations are not anticipated to exceed 5 ft in depth. The Competent Person will perform daily excavation inspections and document such on the Daily Excavation Inspection Checklist. The Competent Person will perform a soils analysis and document such on the Soils Analysis Checklist. Excavated spoils will be staged a minimum of two feet back from the edge of the excavation. Personnel will keep back a minimum of two feet from the edge of all excavations/trenches – the area will be constantly observed for cracks, fissures, or subsidence, and the minimum approach distance increased accordingly.	3/3/M
	Physical Hazard: Collapse	Do not enter excavation unless all hazards have been evaluated and a safe entry plan is in place. If it is necessary to enter excavation that is more than 5 feet, proper sloping is to be utilized.	2/4/M
	Physical Hazard: Vibrations (Potential Cause of Collapse)	Locate the vibratory equipment as far away from the excavation as possible. Divert traffic away from the excavation	2/4/M
	Physical Hazard: Water (Potential Cause of Collapse)	Construct diversion ditches and/or dikes if necessary to prevent water from accumulating in an excavation or trench. Pumps should be used to keep rain and/or ground water from collecting at the bottom of an excavation or trench.	2/4/M
	Physical Hazard: Weight (Potential Cause of Collapse)	Spoils piles shall be stored at least two (2) feet or more from the edge of the excavation or trench.	2/4/M
	Physical Hazard: Noise	Wear hearing protection when an excavator is being used and when working near the excavator.	3/3/M
Intrusive Investigation of	Physical Hazard: Falls	Make sure to have good, solid footing. Make sure that walking/working surfaces are as clean and dry as possible.	3/3/M

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Target Anomalies *(continued)*	Physical Hazard: Equipment Energization	Lockout and tagout is required if accidental energizing of the excavator could cause injury.	3/3/M
	Chemical Hazards	Review material safety data sheets. Follow manufacturer's instruction for use, handling and storage. Use recommended protective equipment. Label all containers.	3/3/M 3/3/M

REQUIRED EQUIPMENT, INSPECTION AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Level D PPE within the exclusion zone (steel/composite toed boots, work pants, blaze orange/yellow clothing and/or reflective safety vests, and work gloves as appropriate) • Magnetometer • Support vehicle • Hand tools (shovel, etc.) • Mini Excavator (if needed) • Emergency equipment including fire extinguisher	• Inspect tools prior to each use • Inspect vehicle daily • Inspect excavator • Inspect emergency equipment/supplies	• Use and limitations of PPE • Valid driver's license • APP and AHA review • Hazardous waste sites require 40 hour HAZWOPER training, annual updates for any intrusive activities. • UXOSO, and all other supervisors, will require HAZWOPER Supervisor's Training and 30-hour OSHA Construction Safety Course.

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ACTIVITY HAZARD ANALYSIS – MUNITIONS AND EXPLOSIVES OF CONCERN AVOIDANCE

Activity/Activities:	**Munitions and Explosives of Concern Avoidance**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	UXOSO/UXOQCS, SUXOS or UXO Technician III						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Instrument-Aided Visual Inspection (MEC Avoidance)	Physical Hazard: Direct contact with MEC	Non-essential employees will obey any posted signage when entering a designated exclusion zone that UXO may be present. Smoking is prohibited. In areas that have not received surface clearance, UXO-qualified personnel will escort all non-UXO qualified staff, and non-UXO qualified staff will receive site-specific UXO awareness training.	1/5/M
		Do not use cell phones or radios within 50 feet of potential MEC, do not disturb the ground in potential MEC areas without consulting UXO-qualified staff, and do not move UXO or MEC. If suspect MEC is observed, evacuate area and notify UXOSO/UXOQCS. Ensure compliance with relevant SOPs and the approved Department of Defense Explosives Safety Board (DDESB) Explosives Site Plan (ESP).	

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Level D PPE within the exclusion zone (steel/composite toed boots, blaze orange/yellow clothing and/or reflective safety vests,) • Magnetometer	• Inspect PPE prior to each use • Inspect magnetometer prior to each use	• Use and limitations of PPE • APP and General AHA review • UXO personnel: qualifications and training per DDESB TP-18 • Non-UXO qualified personnel: project-specific training conducted by UXOSO/UXOQCS to ensure that all onsite personnel fully understand the potential MEC/UXO onsite and MEC avoidance procedures

ACTIVITY HAZARD ANALYSIS – MUNITIONS AND EXPLOSIVES OF CONCERN DETECTOR-AIDED SURFACE/SUBSURFACE CLEARANCE

<table>
<tr><td>Activity/Activities:</td><td>Munitions and Explosives of Concern Detector-Aided Surface/Subsurface Clearance</td><td>Phases: MEC Clearance</td><td colspan="5">Overall Risk Assessment Code (RAC) (highest code from subtasks):</td><td><u>M</u></td><td></td></tr>
<tr><td>Project Location:</td><td colspan="2">Iona Island, New York</td><td colspan="7">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td>Project Number:</td><td colspan="2">63029587</td><td rowspan="2">Severity</td><td colspan="6">Probability</td></tr>
<tr><td>Date Prepared:</td><td colspan="2">12 October 2018</td><td>1
Frequent</td><td>2
Likely</td><td colspan="2">3
Occasional</td><td>4
Seldom</td><td>5
Unlikely</td></tr>
<tr><td rowspan="2">Prepared By:</td><td colspan="2" rowspan="2">M. McGuire</td><td>1 Catastrophic</td><td>E</td><td>E</td><td colspan="2">H</td><td>H</td><td>M</td></tr>
<tr><td>2 Critical</td><td>E</td><td>H</td><td colspan="2">H</td><td>M</td><td>L</td></tr>
<tr><td rowspan="2">Reviewed By:</td><td colspan="2" rowspan="2">P. Garger, CIH, CSP</td><td>3 Marginal</td><td>H</td><td>M</td><td colspan="2">M</td><td>L</td><td>L</td></tr>
<tr><td>4 Negligible</td><td>M</td><td>L</td><td colspan="2">L</td><td>L</td><td>L</td></tr>
<tr><td>Competent and/or Qualified Person(s):</td><td colspan="2">UXOSO/UXOQCS, UXOTIII or SUXOS</td><td colspan="7"></td></tr>
<tr><td colspan="8">Step 1: Review each "hazard" and determine RAC.</td><td colspan="2">RAC Chart</td></tr>
<tr><td colspan="8">Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.</td><td colspan="2">E = Extremely High Risk</td></tr>
<tr><td colspan="8">Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.</td><td colspan="2">H = High Risk</td></tr>
<tr><td colspan="8">Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.</td><td colspan="2">M = Moderate Risk</td></tr>
<tr><td colspan="8"></td><td colspan="2">L = Low Risk</td></tr>
</table>

TASK BREAKDOWN, HAZARDS, AND CONTROLS: MONTHLY INSPECTION AND MAINTENANCE

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Surface/Subsurface Clearance	Physical Hazard: Direct contact with MEC	Ensure Exclusion Zones are established to authorized minimum safe distances for non-project personnel and team separation distances for project personnel. Use the minimum number of personnel (not less than two) to conduct the clearance activities in order to minimize unnecessary exposure to MEC/UXO and ensure all personnel are under the direction of qualified UXO Technicians qualified as per DDESB TP-18. Do not conduct operations within site-specific minimum safe distances of other MEC intrusive operations and observe general MEC hazards and precautions. compliance with relevant standard operating procedures and the DDESB approved ESS.	1/5/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Level D PPE within the exclusion zone (steel/composite toed boots, safety glasses, hard hat [when overhead hazards are present], work pants, blaze orange/yellow clothing and/or reflective safety vests, work gloves) • Magnetometer	• Inspect PPE prior to each use • Inspect magnetometer	• Use and limitations of PPE • APP and General AHA review • UXO Personnel: Qualifications and training per DDESB TP-18

ACTIVITY HAZARD ANALYSIS – MUNITIONS POTENTIALLY PRESENTING IN AN EXPLOSIVE HAZARD INSPECTION

Activity/Activities:	**Munitions Potentially Presenting in an Explosive Hazard Inspection**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom** / **5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H / M
			2 Critical	E	H	H	M / L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L / L
			4 Negligible	M	L	L	L / L
Competent and/or Qualified Person(s):	SUXOS or UXOSO/UXOQCS						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
MPPEH Inspection	Physical Hazard: Exploding ordnance	Specific requirements for MPPEH inspection are detailed in SOP #10 in Appendix C of the UFP-QAPP and the ESP. Assess items to determine if they can be safely moved. If the item cannot be safely moved, it will be blown in place. Inspected and certified MD, range related debris, and materials deemed as safe will be certified.	1/5/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Level D PPE in the exclusion zone (steel/composite toed boots, work pants, blaze orange/yellow clothing and/or reflective safety vests, and work gloves [if necessary]) • Magnetometer • Type II storage magazine • 55-gallon drums (materials deemed as safe, MD)	• Inspect PPE prior to each use • Inspect magnetometer • Inspect magazine, as necessary • Inspect any MD, range related debris, and materials deemed as safe, and associated containers, prior to shipment.	• Use and limitations of PPE • APP and General AHA review • UXO personnel: qualifications and training per DDESB TP-18

ACTIVITY HAZARD ANALYSIS – MUNITIONS AND EXPLOSIVES OF CONCERN DISPOSAL

Activity/Activities:	**Munitions and Explosives of Concern Disposal**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom** / **5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H / M
			2 Critical	E	H	H	M / L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L / L
			4 Negligible	M	L	L	L / L
Competent and/or Qualified Person(s):	SUXOS or UXOSO/UXOQCS						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
MEC Disposal	Physical Hazard: Exploding ordnance	If the item cannot be safely moved, it will be blown in place. Items that are not fused and are acceptable to move will be marked for collection and storage in accordance with the ESP. Demolition operations must be conducted in accordance with the demolition and SOP #8 in Appendix C of the UFP-QAPP and the ESP.	1/5/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Level D PPE within the exclusion zone (steel/composite toed boots, work pants, blaze orange/yellow clothing and/or reflective safety vests, and work gloves [if appropriate]) • Magnetometer • On-call donor explosives • Type II storage magazine • 55-gallon drums	• Inspect PPE prior to each use • Inspect magazine • Inspect magnetometer	• Use and limitations of PPE • APP and General AHA review • UXO personnel: qualifications and training per DDESB TP-18

ACTIVITY HAZARD ANALYSIS – MUNITIONS DEBRIS INSPECTION AND DISPOSITION

Activity/Activities:	**Munitions and Explosives of Concern Inspection and Disposal**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**				**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**					
Project Number:	63029587			**Probability**				
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	M. McGuire		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	SUXOS or UXOSO/UXOQCS							

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
MD Inspection and Disposition	Physical Hazard: MEC	Specific requirements for MD disposal are detailed in the UFP QAPP and Appendix C SOP #10 of the UFP-QAPP. Assess items to determine if MD, if MD proceed. If MPPEH refer to MPPEH AHA or if MEC refer to MEC Disposal AHA.	2/4/M
MD Inspection and Disposition	Physical Hazard: Manual lifting	Follow proper lifting techniques. Use caution and do not twist the back when carrying a load. Do not attempt to lift bulky items or items assessed at over 50 pounds without assistance. Use mechanical devices to move loads when possible. Wear leather gloves for materials handling.	3/3/M
MD Inspection and Disposition	Physical Hazard: Hand tools	Inspect tools prior to use. Use tools for their intended use only. Do not use damaged tools. Push, don't pull, wrenches.	3/3/M

REQUIRED EQUIPMENT, INSPECTION AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Magnetometer • Level D PPE within the exclusion zone (steel/composite toed boots, work pants, blaze orange/yellow clothing and/or Reflective safety vests, and work gloves [if appropriate]) Emergency equipment including fire extinguishers	• Inspect PPE prior to each use • Inspect vehicle daily • Use appropriate PPE • Inspect emergency equipment/supplies	• Use and limitations of PPE • Valid driver's license • APP and General AHA review • Hazardous waste sites require 40-hour HAZWOPER training; annual updates for any intrusive activities. • UXOSO, and all other supervisors, will require HAZWOPER Supervisor's Training.

ACTIVITY HAZARD ANALYSIS – SOIL SAMPLING

Activity/Activities:	**Soil Sampling**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**		**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**			
Project Number:	63029587			**Probability**		
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional** / **4 Seldom** / **5 Unlikely**

Severity	1 Frequent	2 Likely	3 Occasional	4 Seldom	5 Unlikely
1 Catastrophic	E	E	H	H	M
2 Critical	E	H	H	M	L
3 Marginal	H	M	M	L	L
4 Negligible	M	L	L	L	L

Prepared By:	D. Wilt
Reviewed By:	P. Garger, CIH, CSP
Competent and/or Qualified Person(s):	Field Sampling Technician, Field Manager, or SSHO

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability/RAC
Soil Sampling	Chemical Hazard: Dermal exposure to contaminants of concern	Modified Level D PPE when handling soil directly. Sampling tools will be dedicated; dispose of properly. Observe proper hygiene after sampling events and leaving exclusion zone. Wash hands after departing the work zone and conduct a dry decontamination (brushing off) when departing the exclusion zone. Note: exclusion zone boundaries may change based on screening/analytical results.	3/4/L

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Modified Level D PPE (Level D PPE plus nitrile gloves instead of work gloves when handling soil) • Sampling equipment (i.e., bags, jars, scoops)	• Inspect PPE prior to each use	• Use and limitations of PPE • APP and General AHA review

ACTIVITY HAZARD ANALYSIS – SURFACE WATER AND SEDIMENT SAMPLING

Activity/Activities:	**Surface Water and Sediment Sampling**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	D. Wilt		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	SSHO						

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Surface Water and Sediment Sampling	Chemical Hazard: Dermal exposure to contaminants of concern	Modified Level D PPE when handling soil directly. Sampling tools will be dedicated; dispose of properly. Observe proper hygiene after sampling events and leaving exclusion zone. Wash hands after departing the work zone and conduct a dry decontamination (brushing off) when departing the exclusion zone. Note: exclusion zone boundaries may change based on screening/analytical results.	3/4/L
Wading with Chest Waders	Physical Hazard: Slips, trips and falls	Wear an adjustable wading belt or drawstring. The belt should have a quick release feature and be constructed of non-stretch material. The adjustable belt creates a watertight environment from foot to waist and will compartmentalize water that does enter the waders. Wear wading shoes or boots with soles that grip the type of bottom present. Rubber cleat soles are best for sand, fine gravel, soft silt or mud. Felt soles are best for irregular-sized rocks and algae-covered bedrock. Cleated or studded felt soles work well in swift water with a slight rock bottom.	3/3/M
	Physical Hazard: Slips, trips and falls (continued)	Carry a large walking stick or wading staff to provide balance while wading and to check for holes, drop-offs and rocks. Use a pair of metal cramp-ons or cleats that fit over the boot portion of waders to improve traction when wading across slippery rocks and other debris. If you fall, do not panic or try to remove the waders while still in the water. In calm water, wade or swim to shore. In fast moving water, ride the current; pull your feet in front of you and point your toes down current. When you reach calmer water, swim back to shore and empty the waders.	

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• PFDs • Waders • Gloves • Emergency equipment including fire extinguishers	• Inspect PPE prior to each use • Inspect boat daily • Use appropriate PPE • Inspect emergency equipment/supplies	• Use and limitations of PPE • Valid driver’s license • APP and AHA review • Hazardous waste sites require 40-hour HAZWOPER training; annual updates for any intrusive activities. • UXOSO, and all other supervisors, will require HAZWOPER Supervisor’s Training and 30-hour OSHA Construction Safety Course.

ACTIVITY HAZARD ANALYSIS – GROUNDWATER SAMPLING AND WELL DEVELOPMENT/MULTIPLE

Activity/Activities:	**Groundwater Sampling and Well Development**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**			**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**				
Project Number:	63029587			**Probability**			
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	D. Wilt		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	SSHO							
Step 1: Review each "hazard" and determine RAC.							RAC Chart	
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.							E = Extremely High Risk	
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.							H = High Risk	
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.							M = Moderate Risk	
							L = Low Risk	

TASK BREAKDOWN, HAZARDS AND CONTROLS: GROUNDWATER MONITORING/SAMPLING/WELL DEVELOPMENT

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Groundwater Depth Sounding and Well Purging	Chemical Hazards – Exposure to Organic Vapors from Well, Contaminants in Groundwater	Perform environmental monitoring as required in APP. Wear appropriate PPE (including nitrile gloves). Ensure personnel using have been trained on instrument use and site specific action levels/upgrades. Calibrate instrument(s) prior to use. Position personnel and equipment up wind of well.	2/4/M
Well Purging	Physical Hazard: Compressed Air/Air Compressor Incident	Properly secure all compressed air cylinders. Do not allow air/gas to flow freely from gas lines (potentially creating a whip out of the line). Wear PPE (hard hat) when working in proximity compressor/cylinders. Sampler must inspect compressors, well head gas fittings, and regulators prior to use, if faulty or inappropriate, do not proceed until repaired or replaced.	2/5/L
	Physical Hazard: Hearing loss.	Wear PPE (ear plugs) when working in proximity to air compressor.	3/4/L
	Chemical Hazard: Uncontrolled Release of Groundwater	Ensure tubing discharge pressure is controlled and contained in bucket or drum.	2/4/M
	Physical Hazard: Deployment of pump system	Be aware of pinch points, moving equipment	2/4/M
Equipment Decontamination	Chemical Hazard: Decontamination Material Handling and Contaminated Media Residue Exposure	Only those personnel with HAZWOPER training will be allowed to perform equipment decontamination. Material safety data sheets will be maintained on site for decontamination materials/fluids (e.g., detergents, isopropyl alcohol, and/or nitric acid, etc.). Proper PPE will be required, including nitrile gloves and safety glasses. If vigorous scrubbing is required (creating a splash hazard) a face shield and/or disposable coverall may be required at the discretion of the SSHO.	3/4/L

REQUIRED EQUIPMENT, INSPECTION AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Monitoring equipment per Table 7-1 of SSHP • Level D PPE (steel/composite toed boots, safety glasses, hard hat when overhead hazards are present, work pants, blaze orange/yellow clothing and/or reflective safety vests) • Compressed air cylinder brackets • Power tools/hand tools • Air compressor and air lines • Emergency equipment including first aid kit, eye wash, fire extinguishers • Bennett sampling pump system	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use. • Use appropriate PPE • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher) • Inspect air compressor • Inspect gas cylinders	• Use and limitations of PPE • Valid driver's license • Use of monitoring equipment • Lifting • APP and AHA review • Handling of compressed gas cylinders • Use of air compressor • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40 hour HAZWOPER training, annual updates for any intrusive activities. • SSHO will require HAZWOPER 40 hour Worker Training and 30-hour OSHA Construction Safety Course.

ACTIVITY HAZARD ANALYSIS – WELL INSTALLATION (DRILLING)

Activity/Activities:	**Drilling (Well installation and direct push boring)**	**Phases:**	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**				**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**					
Project Number:	63029587			**Probability**				
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	D. Wilt		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	SSHO							

Step 1: Review each "hazard" and determine RAC.	RAC Chart
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.	E = Extremely High Risk
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.	H = High Risk
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.	M = Moderate Risk
	L = Low Risk

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Drilling	Physical Hazard: Injury from heavy equipment (drill rig and support vehicles).	Be aware of the location of equipment, where high visibility safety colors, establish eye contact with operator. Be aware of pinch points, swinging chains, augers, etc. PPE (hard hat) when working within 25 ft of rig.	2/4/M
	Physical Hazard: Faulty or Inappropriate Equipment	Qualified driller must inspect drill rig prior to use, if faulty or inappropriate, do not proceed until repaired or replaced.	2/4/M
	Physical Hazard: Faulty or Inappropriate Equipment	Inspect all hand tools prior to use, if faulty or inappropriate, do not proceed until repaired or replaced. Also follow manufacturers' recommendations regarding hearing and eye protection during operation of all hand tools. Evaluate each operation to determine if safety glasses are adequate for the work being performed and have face shields available as necessary.	2/4/M
	Physical Hazard: Moving Equipment/Rotary and Sonic Drilling	Clear area of obstructions and communicate with all workers involved that drilling is beginning. Do not exceed manufacturer's recommended speed, force, torque, etc. and penetrate the ground slowly with hands on the controls for at least the first foot of soil to minimize chance of auger kick-out. Stay clear of rotating auger and compressed air lines/equipment. Use long-handled shovel to clear away cuttings when auger has stopped. Secure loose clothing. Do not walk under suspended loads. When possible, remove overhead hazards promptly. Wear appropriate PPE including hard hat and steel-toed boots.	3/4/L
	Physical Hazard: Hearing loss.	Where appropriate PPE (plugs) when working in proximity to drill rig.	3/4/L
	Physical Hazard: Material Handling, Moving, Lifting	Observe proper lifting techniques. Use two or more persons for heavy bulk lifting. Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads. Obey sensible lifting limits (50-pound maximum per person manual lifting).	3/4/L
	Physical Hazard: Heat/Cold Stress	Take breaks as needed. Be aware of weather conditions and dress appropriately. Consume adequate food/beverages. If possible, adjust work schedule to avoid heat/cold stresses.	3/4/L
	Physical Hazard: Fire/Explosion	Ensure type ABC, fully charged fire extinguisher on-site. Perform utility clearance (One Call) to avoid possible gas lines. Interview property owner for location of possible private gas/utility lines. Stop work if hazardous conditions are identified.	1/5/M
	Physical Hazard: Electrical	Inspect work areas for spark sources, maintain safe distances, properly illuminate work areas, and provide barriers to prevent inadvertent contact.	1/5/M
	Physical Hazard: Electrical	Maintain minimum clearance distances for overhead energized electrical lines. Use a spotter to confirm clearance of overhead lines and other obstructions. Perform utility clearance (One Call) to avoid possible buried electrical lines. Interview property owners on location of possible private utilities.	1/5/M
Ambient Air Monitoring	Chemical/Physical Hazard: Elevated Organic Vapors and/or Combustible Gases	Approach and stay upwind of potential sources of vapors. Ensure personnel using have been trained on instrument use and site specific action levels/upgrades. Calibrate instrument prior to use.	3/3/M
Drill Rig/Direct Push Relocation /Set-Up	Physical Hazard: Rig Roll Over	Do not move rig with mast raised. Cross all hills and obstructions head on. Set riggers prior to raising mast	2/5/L
	Physical Hazard: Collision with property or personnel	Heavy equipment should be equipped with back-up alarm or use horn when backing. Use spotters when moving in/out of nominal clearance areas.	2/5/L

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Equipment Decontamination	Chemical Hazard: Decontamination Material Handling and Contaminated Media Residue Exposure	Only those personnel with HAZWOPER training will be allowed to perform equipment decontamination. Material safety data sheets will be maintained onsite for decontamination materials/fluids (e.g., detergents, isopropyl alcohol, etc.). Proper PPE will be required, including nitrile gloves and safety glasses. If vigorous scrubbing is required (creating a splash hazard) a face shield and/or disposable coverall may be required at the discretion of the SSHO.	3/4/L

REQUIRED EQUIPMENT, INSPECTION AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Support vehicle • Monitoring equipment per Table 7-1 of the SSHP • Level D PPE (steel/composite toed boots, safety glasses, hard hat, work pants, blaze orange/yellow clothing and/or reflective safety vests, nitrile gloves, face shield and coveralls [decontamination of equipment, splash hazards]) • Heavy equipment • Power tools/hand tools • Emergency equipment including first aid kit, eye wash, fire extinguishers • Drill rig • Decontamination equipment • Respiratory protection if Level C PPE utilized (respirator and appropriate cartridges)	• Inspect PPE prior to each use • Inspect vehicle daily • Calibrate environmental monitoring equipment daily prior to use. • Underground and overhead hazards require clearance • Inspect emergency equipment/supplies daily (first aid kit, eye wash, fire extinguisher) • Inspect and document inspection of drill rig.	• Use and limitations of PPE • Valid driver's license • Use of monitoring equipment • Drill rig operator (and any other large equipment operator) will be trained in equipment use and maintenance (licensed) • Lifting • APP and AHA review • First aid/CPR—at least 2 people on site • Hazardous waste sites require 40 hour HAZWOPER training, annual updates for any intrusive activities. • SSHO will require HAZWOPER Training and 30-hour OSHA Construction Safety Course. • Fit Test for respirator

ACTIVITY HAZARD ANALYSIS – BOATING OPERATIONS

Activity/Activities:	**Boating Operations**	**Phases:** Refer to Table 1	**Overall Risk Assessment Code (RAC) (highest code from subtasks):**				**M**	
Project Location:	Iona Island, New York		**Risk Assessment Code (RAC) Matrix**					
Project Number:	63029587			**Probability**				
Date Prepared:	12 October 2018		**Severity**	**1 Frequent**	**2 Likely**	**3 Occasional**	**4 Seldom**	**5 Unlikely**
Prepared By:	D. Wilt		1 Catastrophic	E	E	H	H	M
			2 Critical	E	H	H	M	L
Reviewed By:	P. Garger, CIH, CSP		3 Marginal	H	M	M	L	L
			4 Negligible	M	L	L	L	L
Competent and/or Qualified Person(s):	Boat Captain							
Step 1: Review each "hazard" and determine RAC.							RAC Chart	
Probability = The likelihood to cause an incident, near miss, or accident. Identified as frequent, likely, occasional, seldom, or unlikely.							E = Extremely High Risk	
Severity = The outcome/degree if an incident, near miss, or accident did occur. Identified as catastrophic, critical, marginal, or negligible.							H = High Risk	
Step 2: Identify the RAC as E, H, M, or L for each hazard on AHA. Select the highest RAC and note at the top of the form.							M = Moderate Risk	
							L = Low Risk	

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
General Health and Safety	General boat operation	Conduct a daily health and safety tailgate meeting to review potential hazards and necessary precautions. Use the buddy system—two people must be present at all times. Boat operator will inspect the boat prior to operation. The operator will ensure the number of PFDs is equal to or greater than the number of passengers onboard. No personnel will embark or disembark the vessel without the direction of the vessel operator. Vessel operator will ensure passengers are wearing PFDs while on deck. At the request of the operator, personnel will be seated. When traveling to and from work areas, passengers will remain seated until the boat is docked or in working data collection mode. Ensure three-point contact whenever possible. A Type IV throwable device will be readily available onboard.	3/3/M
	General boat operation	Swimming is prohibited, with the following exceptions: (1) certified divers performing their duties, (2) personnel adjusting DGM sensors, and (3) personnel entering water to prevent injury or loss of life.	2/4/L
		Each boat measuring less than 26 feet in length will carry one 1A-10 BC fire extinguisher; motored boats measuring greater than 26 feet will carry two 1A-10 BC fire extinguishers.	2/4/M
Boating Operations	Physical Hazard: Slips, trips and falls (including falls overboard)	Keep work area free of excess material and debris Make sure you have good solid footing and that walking/working surfaces are as clean and dry as possible. Inspect areas daily and record findings on daily inspection report. Wear appropriate PPE including non-slip rubber boots. Stay aware of footing and do not run.	3/3/M
Boating Operations	Physical Hazard: Cold stress	Wear cold weather clothing and provide shelter as needed based on site conditions. Conduct temperature monitoring when temperatures fall below 45˚F.	3/3/M
Boating Operations	Physical Hazard: Heat stress	Make drinking water available to all workers and encourage workers to drink small amounts of water frequently. Adjust work/rest regimens during hot weather.	3/3/M
Boating Operations	Physical Hazard: Extreme weather	Monitor radio for up-to-date severe weather forecasts. Discontinue work and disembark during thunderstorms, high winds and other severe weather events.	2/4/M

TASK BREAKDOWN, HAZARDS, AND CONTROLS

Work Task Steps	Hazards	Controls	Severity/ Probability /RAC
Boating Operations	Physical Hazard: Water hazards	Wear PFD/life jackets. Identify unsafe conditions, obstructions, or objects that could cause a slip, trip or fall. Carry a first aid kit, a cell phone, two-way radios, and extra food and water in case of emergency.	3/3/M
Boating Operations	Biological Hazards: Insects	Use repellents and proper clothing for protection against insects including ticks and mosquitoes.	4/3/L
Boating Operations	Physical Hazard: Manual lifting	Follow proper lifting techniques. Use caution and do not twist the back when carrying a load. Do not attempt to lift bulky items or items assessed at over 50 pounds without assistance. Use mechanical devices to move loads when possible. Wear leather gloves for materials handling.	3/3/M
Mobilization/Demobilization	Physical Hazard: Driving	Drivers to, from, or at the site must possess a valid state driver's license. Drivers shall observe all traffic laws and practice safe driving skills while traveling to, from, and onsite. Drivers should not use cell phones while driving. Follow posted speed limits and obey traffic/roadway signs. Follow the "Rules of the Road." Review/make yourself familiar with maps and driving directions before beginning the drive to the site. Pull over to a safe place if you experience any signs of fatigue or drowsiness. In inclement weather, drive as road conditions allow and at least 5-10 miles per hour below the speed limit. Check the mirrors on a regular basis to be aware of vehicles around you.	3/3/M
Mobilization/Demobilization	Physical Hazard: Manual lifting	Follow proper lifting techniques. Use caution and do not twist the back when carrying a load. Do not attempt to lift bulky items or items assessed at over 50 pounds without assistance. Use mechanical devices to move loads when possible. Wear leather gloves for materials handling.	3/3/M
Wading with Chest Waders	Physical Hazard: Slips, trips and falls	Wear an adjustable wading belt or drawstring. The belt should have a quick release feature and be constructed of non-stretch material. The adjustable belt creates a watertight environment from foot to waist and will compartmentalize water that does enter the waders. Wear wading shoes or boots with soles that grip the type of bottom present. Rubber cleat soles are best for sand, fine gravel, soft silt or mud. Felt soles are best for irregular-sized rocks and algae-covered bedrock. Cleated or studded felt soles work well in swift water with a slight rock bottom. Carry a large walking stick or wading staff to provide balance while wading and to check for holes, drop-offs and rocks. Use a pair of metal cramp-ons or cleats that fit over the boot portion of waders to improve traction when wading across slippery rocks and other debris. If you fall, do not panic or try to remove the waders while still in the water. In calm water, wade or swim to shore. In fast moving water, ride the current; pull your feet in front of you and point your toes down current. When you reach calmer water, swim back to shore and empty the waders. When tethered, support personnel will extract you from the water.	3/3/M

REQUIRED EQUIPMENT, INSPECTION, AND TRAINING

Equipment	Inspection Requirements	Training Requirements (including Competent Person and Qualified Personnel, if applicable)
• Boat • PFDs • Waders • Gloves • Emergency equipment including fire extinguisher	• Inspect PPE prior to each use • Inspect boat daily • Use appropriate PPE • Inspect emergency equipment/supplies	• Use and limitations of PPE • Valid driver's license • APP and AHA review • Boat operator will be trained in equipment use and maintenance • USCG training and certificates (for boat operators) • Hazardous waste sites require 40-hour HAZWOPER training; annual updates for any intrusive activities. • UXOSO, and all other supervisors, will require HAZWOPER Supervisor's Training and 30-hour OSHA Construction Safety Course.

Appendix B

Occupational Safety and Health Administration 300 Form

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

Year 2017

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information 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 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 EA Engineering, Science, and Technology, Inc., PBC

City Hunt Valley State Maryland

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 (mo./day)	(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)	Job transfer or restriction (I)	Other record- able cases (J)	Away From Work (days) (K)	On job transfer or restriction (days) (L)	Injury (1)	Skin Disorder (2)	Respiratory Condition (3)	Poisoning (4)	Hearing Loss (5)	All other illnesses (6)
1		geologist 1	5/3	Kirtland AFB project , parking lot north of Bullhead park	broken nose from collision with service dog			x			7	x					
2		scientist 1	6/30	Howard County Recs and Parks, Columbia MD	bee sting with allergic reaction and prescription meds				x			x					
3		technician 2	7/10	on the Missouri River near Brownville, NE	employee wiped eye with formalin solution on hands				x			x					
4		project mgr	8/12	FCC, Louisiana - Camp Clairborne	laceration to right ring finger requiring stitches				x			x					
5		technician 3	8/14	Sprague Road Project, Odessa , Texas	sulfuric acid burn to back from faulty pipe connection				x			x					
6		uxo tech	8/24	Joint Base Cape Cod , old K range	pulled shoulder muscle going through thick vegetation				x			x					
7		geologist	8/14	Waugh Chapel Town Center, Maryland	tick bite with bullseye rash - rash not noted until 8/28				x			x					
					Page totals	0	0	1	6	0	7	7	0	0	0	0	0

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Injury	Skin Disorder	Respiratory Condition	Poisoning	Hearing Loss	All other illnesses
(1)	(2)	(3)	(4)	(5)	(6)

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instruction, 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 aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2017

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 injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

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 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
0	0	1	6
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	7
(K)	(L)

Injury and Illness Types

Total number of...
(M)

(1) Injury	7	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

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 50 minutes per response, including time to review the instruction, 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 aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name: EA Engineering, Science, and Technology Inc., PBC

Street: 225 Schilling Circle

City: Hunt Valley State: Maryland Zip: 21031

Industry description (e.g., Manufacture of motor truck trailers): Environmental Remediation and Consulting

Standard Industrial Classification (SIC), if known (e.g., SIC 3715): ___ ___ ___ ___

OR North American Industrial Classification (NAICS), if known (e.g., 336212): 5 6 2 9 1 0

Employment information

Annual average number of employees: 514

Total hours worked by all employees last year: 1,072,638

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: [signature] | Title: President and CEO

Phone: 410 584-7000 | Date: 8-Jan-18

Appendix C

Resumes and Certifications of Key Personnel

(Any certification that is set to expire prior to, or during, field activities will be renewed before said expiration date. Onsite files will be amended with current certifications as appropriate.)

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Peter Garger, CIH, CSP

Director of Safety and Health/Safety and Health Manager

Mr. Garger has more than 34 years of experience managing and conducting industrial hygiene services including hazardous materials surveys and assessments, health and safety inspections and oversight on both environmental remediation projects as well as industrial operations.

During his career, he has performed sampling and evaluation of numerous occupational environments for airborne contaminants and made recommendations for their control. In addition, Mr. Garger has been involved in Occupational Safety and Health Program development in both the private sector and in the federal government arena. He has extensive experience in technical report preparation, regulatory interpretation and technical briefing to all levels within an organization.

Qualifications

Education

ScM; Johns Hopkins University School of Hygiene and Public Health; 1981
B.A.; Hofstra University; Chemistry; 1978

Registrations/Certifications

Certified Safety Professional—2008 (No. 20560)
Certified Industrial Hygienist—ABIH No. 3118; 1985

Specialized Training

OSHA Construction Outreach Trainer for 10- and 30-Hour Construction Safety Training
OSHA Hazardous Waste Supervisor, 1989 – Present
Investigating and Mitigating Microbial Contamination in Buildings; 1995
U.S. Army Corps of Engineers – Unexploded Ordnance Training; 1994
Department of Transportation Hazmat Training; 1994
National Institute for Occupational Safety and Health 582 Microscopic Evaluation of Fibers; 1993
Asbestos Building Inspector/Management Planner; 1993
X-Ray Fluorescence Testing Operator – Lead Paint Analysis; 1992

Professional Affiliations/Appointments

American Board of Industrial Hygiene
American Industrial Hygiene Association
Board of Certified Safety Professionals

Experience

Years with EA: 8 Total Years: 34

Professional Experience

Occupational Safety and Health Program Development—Held the position of Corporate Health and Safety Director for several private firms over the last 17 years. In addition, held the position of Chief of the Industrial Hygiene and Chemistry Section at the U.S. Army Corps of Engineers–Baltimore District. These positions involved the coordination of training activities, development and maintenance of the medical surveillance programs including the drug testing programs, providing overall coordination of all safety and health related project activities, as well as providing health and safety auditing of field activities during project execution. These field activities typically included soil sampling, groundwater monitoring and well installation, contaminated soil remediation and removal and hazardous waste disposal.

Industrial Hygiene/Asbestos/Lead Evaluation—Project experience has involved providing comprehensive industrial hygiene services to a 350-man chromium chemicals manufacturing plant that was followed by assignment as a regional Industrial Hygiene Manager for a complete business unit of a major chemical manufacturer. Held positions within the federal government and the private sector that involved the development and implementation of comprehensive testing programs for both asbestos-containing materials and lead-based paint. Was involved in the development of operations and maintenance plans for these materials as well as in the design of asbestos and lead abatement projects

Munitions and Explosives of Concern/Chemical Warfare Materials—Project experience has included providing safety and health services for the evaluation, decontamination, and demolition of several moth-balled Army Ammunition Plants. The contaminants of concern included trinitrotoluene, cyclotrimethylenetrinitraniine, nitrocellulose, and nitroglycerin as well as ordnance-related items and scrap associated with these plants. Was involved in the preparation and execution of an Open Burn Permit in the State of Illinois to allow for the controlled thermal degradation of numerous process buildings at an old Army site. Project experience also included work for the U.S. Army Corps of Engineers at the Chemical Agent cleanup project in the Spring Valley section of Washington, D.C.

Selected Publications and Presentations

Garger, P. 2007. Construction Site Safety Issues. Presented at the Design Law for Maryland Architects and Engineers, Columbia, Maryland. 27 September.

EA Project Experience

U.S. Environmental Protection Agency 316(b) Sampling at Kewaunee Nuclear Power Plant, Wisconsin— Performed safety and health audit of field work being conducted.
Project Date: 2006

U.S. Environmental Protection Agency Region 6 Sol Lynn Superfund Site, Houston, Texas—Performed safety and health audit of groundwater monitoring being performed and an additional safety audit during injection of emulsified vegetable oil solution for remediation of groundwater contaminants.
Project Date: 2007-2010

U.S. Environmental Protection Agency Region 6 Sprague Road Superfund Site, Odessa, Texas—Performed safety and health review along with assisting in a process review at the project site.
Project Date: 2007

U.S. Environmental Protection Agency Region 6 Garland Road Superfund Site, Longview, Texas—Performed two safety and health reviews during the duration of this contaminated soil excavation and landfill capping project.
Project Date: 2009-2010

U.S. Environmental Protection Agency Region 6 Texarkana Wood Preserving, Texarkana, Texas—Assisted in the development of the project health and safety plan including air monitoring requirements.
Project Date: 2010

Boomsnub/Airco Superfund Site, Vancouver, Washington; BOC Gases—Reviewed project Health and Safety Plan and performed safety and health audit during quarterly groundwater sampling event.
Project Date: 2007

Lake Ontario Ordnance Works, Buffalo, New York; U.S. Army Corps of Engineers–Baltimore District— Performed site safety and health audit during excavation of sewer lines for sampling.
Project Date: 2006

Fort Drum Gasoline Alley, Watertown, New York; U.S. Army Corps of Engineers–Baltimore District—Performed site safety and health audit at various project locations at Fort Drum.
Project Date: 2006

Fort Drum Surfactant Enhanced Aquifer Remediation, Watertown, New York; U.S. Army Corps of Engineers–Baltimore District—Performed site safety and health audit during pilot test phase of this project.
Project Date: 2010

U.S. Environmental Protection Agency Region 6; Many Diversified Industries Superfund Site, Houston, Texas— Performed site safety and health audit at this project location which involved lead testing of residential community adjacent to site.
Project Date: 2008

U.S. Army Corps of Engineers–Omaha District, Atlas (Former Lincoln Air Force Base) Superfund Site, York, Nebraska—Performed site safety and health audit at this project location that involved several pumping stations at the site.
Project Date: 2010

U.S. Environmental Protection Agency Region 6; State Road 114 Superfund Site, Levelland, Texas—Performed two site safety and health audits at this project location which involved installation of a soil vapor extraction system and installation of residential water wells.
Project Date: 2009

U.S. Environmental Protection Agency Region 6; Iron King Mine Superfund Site, Prescott, Arizona—Performed site safety and health audit at this project location that involved installation of a groundwater monitoring wells at this arsenic and lead contaminated site.
Project Date: 2008

U.S. Environmental Protection Agency Region 6; Bandera Road Superfund Site, San Antonio, Texas—Performed site safety and health audit at this project location which involved installation of a groundwater monitoring wells and under slab evaluation for vapor intrusion of volatile organic compounds.
Project Date: 2008

U.S. Environmental Protection Agency Region 3; Atlantic Wood Industries Superfund Site, Norfolk, Virginia— Provided senior technical review of the site-specific safety and health plan for this project that involved both onshore and offshore sampling of contaminants. In addition, performed a health and safety audit during Elm Avenue storm drain relocation work on this project site.
Project Date: 2008 – Present

U.S. Environmental Protection Agency Region 3; Greenwood Chemical Superfund Site, Greenwood, Virginia— Performed senior technical review of site safety and health plan for this project which involved operations and maintenance of an onsite treatment system.
Project Date: 2008

New York State Department of Environmental Conservation, Empire Electric Site, Brooklyn, New York— Performed site safety and health audit for this project that involved sampling and characterization of a polychlorinated biphenyl contaminated site.
Project Date: 2008

Harper-Thiel Electroplating Site, Newark, Delaware; Delaware Department of Natural Resources and Environmental Control—Performed site safety and health audit for this project which involved decontamination and demolition of an old electroplating facility contaminated with various heavy metals including hexavalent chromium.
Project Date: 2008

Cabrera Services, Aberdeen Pulse Radiation Facility—Served as one of the site safety and health officers for this project which involved decontamination and demolition of an old army pulse radiation test facility.
Project Date: 2009

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, St. Paul Island, Alaska— Performed site safety and health review of catwalks and related structures at the Northern Fur Seal Rookery.
Project Date: 2009

National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, Maryland—Performed Operational Risk Management review of fish inspection services performed by National Oceanic and Atmospheric Administration personnel.
Project Date: 2010

Aberdeen Proving Ground, Known Distance Range Site 30b, A; Aberdeen Proving Ground, Maryland— Conducted site safety and health audit for this project that involved clearing and grubbing and excavation of small arms waste from a former earthen backstop.
Project Date: 2008

New Mexico Formerly Used Defense Sites Health and Safety Plan—Assisted Bristol Environmental with the development of the Site Safety and Health Plan for the evaluation of numerous Formerly Used Defense Sites in New Mexico.
Project Date: 2010

Layon Landfill Groundwater Monitoring Sites Health and Safety Plan—Assisted Gershman, Brickner and Bratton in the development of the requirements for the Site Safety and Health Plan for the construction of the Layon Landfill, Inarajan, Guam.
Project Date: 2010

Washington Suburban Sanitary Commission, Montgomery County, Maryland—Performed site safety and health audit at this project location that involved installation of a 4-mile underground water tunnel to supply Washington, D.C.
Project Date: 2011

Former Monaca Air Force Base Petroleum, Oil, and Lubricant Facility, Monaca, Pennsylvania—Assisted in the development and implementation of the Accident Prevention Plan/Site Safety and Health Plan for this project which involved confined space entry into larger underground storage tanks.
Project Date: 2011

Hill Air Force Base Basewide Operations and Maintenance, Ogden, Utah; Air Force Center for Engineering and the Environment—Performed site safety and health audit at this project location which was performed completely by subcontract American Environmental and Engineering Consultants, LLC. Visited a majority of the working project sites during the review.
Project Date: 2011

Puchack Well Field Superfund Site, Pennsauken, New Jersey—Assisted in the development of the Accident Prevention Plan/Site Safety and Health Plan for this project involving *in situ* chemical fixation of hexavalent chromium contaminated groundwater. Also performed several site safety and health audits during the course of the project.
Project Date: 2012

Former Monaca Air Force Base Petroleum, Oil, and Lubricant Facility, Monaca, Pennsylvania—Assisted in the development and implementation of the Accident Prevention Plan/Site Safety and Health Plan for this project which involved the removal and disposal of large underground storage tank and asbestos covered piping at this site.
Project Date: 2012

U.S. Army Corps of Engineers–Omaha District, Offutt Air Force Base Military Munitions Response Program Site, Nebraska—Performed site safety and health audit at this project location that involved the location and excavation of potential unexploded ordnance items.
Project Date: 2012

Air Force Center for Engineering and the Environment; Eielson Air Force Base Multi Sites, Eielson Air Force Base, Alaska—Performed site safety and health audit at this project location that involved low flow sampling of monitoring wells adjacent to an active runway at the base..
Project Date: 2012

Prince Georges County Government; Brown Station Road Landfill, Prince Georges County, Maryland—Performed site safety and health audit at this project location which involved confined space entry adjacent to an active sanitary landfill to install new valves in the leachate collection system.
Project Date: 2012

U.S. Environmental Protection Agency Region 6; Donna Canal Remedial Investigation/Feasibility Study, Hidalgo, Texas—Performed site safety and health audit at this project location that involved sampling of sediments in the Donna Canal and the Rio Grande River.
Project Date: 2012

Starr Indemnity and Liability Insurance Company, Various Site Safety Audits—Performed onsite safety audits of Creamer Environmental project sites in New Jersey under this blanket work order EA has with Starr.
Project Date: 2012 and 2013

SECO Audits 2013-2014; National Oceanic and Atmospheric Administration—Performed onsite safety audits of Radar Operations Center, Norman, Oklahoma.
Project Date: 2013

Hill Air Force Base Performance-Based Remediation Contract; Air Force Civil Engineer Center—Involved in the preparation of health and safety plans for the first several task orders under this contract at Hill Air Force Base, Utah.
Project Date: 2013

U.S. Army Corps of Engineers–Omaha District, Offutt Air Force Base, Omaha, Nebraska—Performed site safety and health audit at this project location that involved soil excavation and munitions evaluation
Project Date: 2012

Air Force Civil Engineering Center, Massachusetts Military Reservation—Performed site safety and health audit of EA operations and maintenance project at the site.
Project Date: 2012

U.S. Army Corps of Engineers–Omaha District, Arnold Air Force Base, Tullahoma, Tennessee—Performed site safety and health audit at this project location that involved soil excavation and munitions evaluation.
Project Date: 2013

U.S. Army Corps of Engineers–Omaha District, Langley Air Force Base, Langley, Virginia—Performed site safety and health audit at this project location that involved soil excavation and munitions evaluation.
Project Date: 2013

U.S. Army Corps of Engineers–Omaha District, Andrews Air Force Base, Maryland—Performed several site safety and health audits at this project location that involved soil excavation and munitions evaluation.
Project Date: 2014

Delaware Department of Natural Resources and Environmental Control Hamilton Park Site, New Castle, Delaware—Performed site safety and health audit at this project location that involved soil excavation in a residential community setting.
Project Date: 2014

Other Project Experience

Joliet Army Ammunition Plant, Joliet, Illinois; Volunteer Army Ammunition Plant, Chattanooga, Tennessee; Twin Cities Army Ammunition Plant, Arden Hills, Minnesota; Badger Army Ammunition Plant, Baraboo, Wisconsin; Project Safety and Health Officer; 1999-2003—Provided site safety and health oversight during the evaluation, decontamination, and demolition of numerous explosives manufacturing buildings on the sites listed above. This work often involved both pre-demolition asbestos and lead abatement as well as removal of other hazardous materials such as mercury and polychlorinated biphenyls prior to building demolition. In several instances, open burning was the technique used for decontamination of the explosives residue.

Time-Critical Removal Action, Former Backstop Area Formerly Used Defense Site; Harley-Davidson Plant, York, Pennsylvania; 2004—Served as the project manager on this time-critical removal action involving the removal of potential unexploded ordnance from two former backstop areas located on the Harley-Davidson property. Project involved removal and sifting of the sand in two former backstop areas and inspection of the sifting operation by unexploded ordnance trained personnel. Remote opening by drilling was used on the first several items removed from the sand to determine if they contained any explosive materials or were only practice rounds containing sand.

In addition to the unexploded ordnance inspection, the residual sand materials was tested for lead content and segregated into separate piles according to the analytical results to reduce the volume of hazardous waste to be shipped offsite.

***Fort Meade Landfill Gas Extraction System, Fort Meade, Maryland; 2003-2004*—**Provided site health and safety oversight during the installation and startup of a landfill gas extraction/flare system at the Fort Meade Sanitary Landfill. Work involved extensive trenching work as well as continuous monitoring for explosive gases. Coordinated training in safe trenching and shoring techniques for site employees.

***Marsh Run Dual Vapor Extraction System, New Cumberland, Pennsylvania; 2003-2004*—**Provided site health and safety oversight during the installation of extraction wells and air stripping units at this former landfill site. Coordinated with U.S. Army Corps of Engineers representatives during both project planning and execution stages.

***Fort Meade Lake Allen Spillway Demolition, Fort Meade, Maryland; 2003*—**This project involved the demolition and removal of the spillway at the Lake Allen area of Fort Meade. Health and safety challenges during this project included not only routine construction/demolition hazards and working around water, but also included the possible presence of unexploded ordnance in the footprint of the project. Coordinated all aspects of project health and safety and worked with the unexploded ordnance subcontractor to coordinate all excavation work. Project was conducted on a Sunday to Wednesday schedule to accommodate the needs of the nearby firing range.

***District of Columbia Public Schools, Washington, D.C.; 1997-1999*—**Project experience included initial coordination meetings between the DC Public Schools and the U.S. Army Corps of Engineers–Baltimore District in providing comprehensive safety and health oversight for the asbestos and lead abatement programs. Involved with numerous government entities as well as subcontractors in providing these services over a several year period.

***Spring Valley, Chemical Warfare Materials Cleanup Program, Washington, D.C.; 1995-1998*—**This project involved the evaluation and removal of chemical warfare materials form the Spring Valley section of Washington, D.C. Project experience included work for a private environmental contractor during the initial phases of the project that included health and safety oversight during the waste removal effort. Subsequent project experience while at the U.S. Army Corps of Engineers–Baltimore District included health and safety program development and execution for follow-on phases of the Spring Valley Project.

***Housing Authority of Baltimore City, Baltimore, Maryland; 1992-1994*—**Project experience included managing the comprehensive industrial hygiene services provided to support large asbestos and lead abatement contract with the Housing Authority of Baltimore City. Responsible for the preparation of contract specifications for numerous asbestos and lead abatement projects during the course of this contract. This position also involved the coordination of the laboratory's participation in the National Institute for Occupational Safety and Health Proficiency Analytical Testing Program.

***Allied Signal Chrome Chemicals Remediation Project, Baltimore, Maryland; 1989-1992*—**Project experience included providing all safety, health, and environmental control at the job site. Coordinated all aspects of onsite training for demolition employees and was also responsible for conducting pilot testing for decontamination of chrome and asbestos-contaminated building materials.

Employment History

Employer—EA Engineering, Science, and Technology, Inc.
Dates of Employment—2006 – Present
***Title*—**Corporate Health and Safety Director

Employer—Plexus Scientific/Explosive Technologies and Services Corporation
Dates of Employment—1999–2005
***Title*—**Corporate Health and Safety Director

Employer—U.S. Army Corps of Engineers–Baltimore District, Hazardous, Toxic, and Radioactive Waste Branch
Dates of Employment—1996–1999

Title—Chief, Industrial Hygiene and Chemistry Section

Employer—Dow Environmental
Dates of Employment—1994–1996
Title—Eastern Region Health and Safety Manager

Employer—Martel Labs
Dates of Employment—1992–1994
Title—Industrial Hygiene Services Manager

Employer—International Dismantling and Machinery Corporation
Dates of Employment—1989–1992
Title—Site Health and Safety Manager, Chromium Chemicals Remediation Project

Employer—U.S. Army, Aberdeen Proving Ground
Dates of Employment—1987–1989
Title—Industrial Hygiene Team Leader, Edgewood Area, Aberdeen Proving Ground

Employer—Allied Chemical Corporation
Dates of Employment—1984–1987
Title—Eastern Region Industrial Hygiene Manager

Employer—Allied Chemical Corporation
Dates of Employment—1980–1984
Title—Plant Industrial Hygienist, Baltimore Chrome Works

List of Technical Skills and Specializations

- Certified Industrial Hygienist
- Certified OSHA 30-Hour Construction Safety Trainer
- Certified Safety Professional

Denise E. Wilt, P.G.
Plan Preparer

Ms. Wilt is a geologist with EA's Site Characterization Group with over 17 years of experience working for federal and state government agencies as well as private sector clients. She is a registered Professional Geologist in the Commonwealth of Pennsylvania. Ms. Wilt's technical expertise includes site assessments; site investigations; groundwater, soil, and air sampling; geophysical surveys; laboratory data interpretation; technical writing; soil and groundwater remedial system designs; feasibility studies; and Phase I environmental site assessments. She has a working knowledge of federal, state, and local government environmental regulations.

Qualifications

Education
M.A.; Binghamton University; Geology; Binghamton, New York; 1999
B.A.; Bucknell University; Geology; Lewisburg, Pennsylvania; 1994

Registrations/Certifications
Professional Geologist—PA (No. PG004575); 2005

Specialized Training
OSHA 40-Hour Hazardous Waste Site Worker Safety Training; 1999
OSHA 8-Hour Hazardous Waste Site Worker Refresher; Current
OSHA 30-Hour Construction Safety Training; 2009
CPR and First Aid Training; Current
OSHA 8-Hour Hazardous Waste Operations Supervisor Training; 2008
X-Ray Fluorescence Spectrum Analyzer Training
EA Project Manager Training; 2009
Construction Quality Management for Contractors; U.S. Army Corps of Engineers Learning Center; 2011
Accident Prevention Plans for Contractors, Maryland AGC, 2015

Professional Affiliations/Appointments
Pennsylvania Council of Professional Geologists
Society of Women Environmental Professionals

Experience
Years with EA: 14.5 Total Years: 17

Professional Experience

Health and Safety—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1. Acted as an U.S. Army Corps of Engineers-approved Site Health and Safety Officer on several projects and is also responsible for submitting field exposure hour reporting to the U.S. Army Corps of Engineers.

Relevant Project Experience

Former Frankford Arsenal, Philadelphia, Pennsylvania; U.S. Army Corps of Engineers–Baltimore District; Task Manger/Project Geologist—Prepared and presented project status update to stakeholders throughout all stages of the investigation, file review of existing documents, and preparation of conceptual site model and planning documents including the Accident Prevention Plan (APP). Site characterization and remedial investigation activities included the installation of over 130 soil borings, collection of over 300 surface and subsurface soil samples, installation and sampling of 27 temporary wells, and installation and sampling of 11 monitoring wells in a complex urban environment.
Project Date: January 2011 – January 2017

Performance-Based Remediation, Kirtland Air Force Base, New Mexico; U.S. Army Corps of Engineers, Albuquerque District, Geologist—Preparation and revision of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1 for a project that requires implementation of a Resource Conservation and Recovery Act Interim Measure for expanding the groundwater treatment system at Solid Waste Management Unit ST-106/SS-111 at Kirtland Air Force Base, New Mexico. Evaluation of project tasks to determine applicable plans, activity hazard analyses, monitoring requirements, and personal protective equipment needs. Revision of the APP as needed based on additionally awarded tasks, currently on Revision 4. Performance-Based Remediation, Kirtland Air Force Base, New Mexico; U.S. Army Corps of Engineers–Albuquerque District, Project Manager—Project requires implementation of a Resource Conservation and Recovery Act Interim Measure for expanding the groundwater treatment system at Solid Waste Management Unit ST-106/SS-111 at Kirtland Air Force Base, New Mexico for containment of the dissolved-phase ethylene dibromide off-base plume associated with the Bulk Fuel Facility and historical releases of JP-4, JP-8, and Avgas. The project included installation of a large diameter groundwater extraction well into the regional aquifer that occurs at a depth of approximately 460 ft below ground surface. Additional nested groundwater monitoring wells were installed at multiple depths for collection of data supporting

the vertical profile of the dissolved-phase ethylene dibromide plume. Dual-walled conveyance lines will be installed from the off-base extraction well to the groundwater treatment system building on Kirtland Air Force Base. The groundwater treatment system expansion included the construction of a second 400 gallons per minute granular activated carbon filter treatment system and the design of sand filters for both treatment trains with total capacity of 800 gpm. EA is responsible for the operation and maintenance of the groundwater treatment system, maintenance and operation of the groundwater monitoring network comprised of 140 deep, regional aquifer wells. Additional task associated with the groundwater treatment system include hazardous and nonhazardous waste management, performing line locates for the off-base extraction system, community relations support, and preparing all reporting plans and documents required to implement the Interim Measure. Future discharge options for the treated groundwater will be implemented through installation of additional regional aquifer injection wells and/or injection well galleries and conveyance lines to discharge treated water from the groundwater treatment system building to the injection area.
Project Date: 2015 – Present

Performance-Based Remediation, White Sands Missile Range, New Mexico; U.S. Army Environmental Command, Geologist—Preparation and revision of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1 for a project that includes environmental remediation services for 82 sites located at the White Sands Missile Range, New Mexico under the installation's Resource Conservation and Recovery Act Permit. White Sands Missile Range is an active installation serving as the U.S. Army's largest rocket and missile development and testing facility and is the largest land area military installation in the United States, comprised of 3,200 square miles of land. Project tasks include Release Assessments, Accelerated Corrective Action, Resource Conservation and Recovery Act Facility Investigations, Interim Measures, Corrective Measures, and Closure Plans/Post-Closure Care Plans, periodic groundwater monitoring. Evaluation of project tasks to determine applicable plans, activity hazard analyses, monitoring requirements, and personal protective equipment needs.
Project Date: 2015

Fort Lee Environmental Remediation, Fort Lee, Virginia; U.S. Army Environmental Command; Task Manger/Project Geologist—Prepared planning documents including the field sampling plan and aided in preparation of the Accident Prevention Plan. Coordinated the team conducting investigation report including coordination with management of data generated during the investigation. Conducts field audits during sampling events.
Project Date: January 2014 – Present

Fort Meyer; Arlington, Virginia; Project Geologist—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1for a remedial investigation.
Project Date: September 2014

Long-Term Response Action; DeRewal Chemical Company Superfund Site; U.S. Army Corps of Engineers; Site Health and Safety Officer—Preparation and implementation of an Accident Prevention Plan. Responsible health and safety during ongoing operation and maintenance of a groundwater extraction system in Frenchtown, New Jersey. The groundwater extraction system consists of four extraction wells connected to a 20,000-gallon underground storage tank that holds groundwater until tanker trucks can visit the site to remove the water. Duties also included ensuring proper personal protective equipment was utilized and health and safety practices are followed during operation and maintenance of system.
Project Date: 2012 – November 2014

Monaca, Pittsburgh, Pennsylvania; U.S. Army Corps of Engineers–Baltimore District; Project Geologist/Site Health and Safety Officer—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1for cleaning of five 1.74-million-gal underground storage tanks and associated pipeline. U.S. Army Corps of Engineers-approved Site Health and Safety Officer, monitoring of environmental parameters, enforcing proper use of personal protective equipment, and associated reporting for pipeline cleaning task. Provided technical input in relation to analytical data and Pennsylvania Department of Environmental Protection Land Recycling Program.
Project Date: January 2011 – 2013

Project Value – $2,877,757; Contract Type – LS; EA Project No. – 6220211; EA Project Manager – Michael O'Neil

Fort Meade System Demo; Fort Meade, Maryland; Project Geologist—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1for the demolition of a remediation system.
Project Date: December 2012

Puchack Well Field Superfund Site, Pennsauken, New Jersey; U.S. Army Corps of Engineers–Kansas City District; Project Geologist—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1 for the remediation of hexavalent chromium in groundwater via in-situ treatment. Sampling of monitoring wells and redevelopment of existing wells to recondition them for use as injection wells. Conducted pumping tests and well development of newly installed wells.
Project Date: June–September 2011, April 2013, and June to November 2014

Removal of 33 Underground Storage Tanks, Joint Base McGuire-Dix-Lakehurst, New Jersey; U.S. Army Corps of Engineers–Baltimore City District; Site Health and Safety Officer/Project Geologist—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1 for the removal of 33 underground storage tanks. U.S. Army Corps of Engineers-approved Site Safety and Health Officer responsible for proper use of personal protective equipment, environmental monitoring, and daily health and safety briefings. Responsible for monthly submission of field exposure hours to U.S. Army Corps of Engineers. Provides technical input for planning stages of field activities. Additional delineation sampling to determine remediation required in tank excavations. Oversight of geotechnical sampling.
Project Date: May 2011 – January 2014

Marsh Run Park, Fairview Township, York County, Pennsylvania; U.S. Army Corps of Engineers–Baltimore District; Task Manager/Project Geologist/Site Health and Safety Officer—Additional site characterization of a chlorinated solvent plume associated with a former landfill with the end goal of site closure via the Pennsylvania Department of Environmental Protection Land Recycling Program. Prepared and presented project status update to stakeholders, file review of existing documents, and preparation of conceptual site model, planning documents, and five-year review. Installation of two additional monitoring wells, including oversight of geophysical well logging and installation of a multi-level sampling system, conducted straddle packer and pumping testing and associated groundwater sampling, and sampling of soil. Acted as Site Health and Safety Officer for several field events. Responsible for monthly submission of field exposure hours to U.S. Army Corps of Engineers. Provided ongoing historical knowledge of site in support of site closure and restoration tasks.
Project Date: July 2009 – September 2014

Atlantic Wood Industries Superfund Site, Portsmouth, Virginia; U.S. Environmental Protection Agency; Project Geologist—Pre-remedial design investigation at a 48-acre Superfund site. Prepared planning documents including a Health and Safety Plan, responsible for site management of land based field investigation, additional characterization and delineation of previously identified contamination, and preparation of technical memorandums summarizing investigation findings. Provides continuing site support as needed, including relief as Site Manager. Conducted delineation of dense non-aqueous phase liquid in the subsurface in support of remedial design efforts. Design of pumping test to determine flow conditions around a groundwater interceptor trench and evaluation of sheet pile wall on adjacent property.
Project Date: June 2008 – Present

Foster Wheeler Energy Site, Mountain Top, Pennsylvania; U.S. Environmental Protection Agency; Task Manager—Prepared an Oversight Technical Plan, Health and Safety Plan, and Quality Assurance Project Plan to support oversight of a remedial investigation and feasibility study at the Foster Wheeler trichloroethene site on behalf of the U.S. Environmental Protection Agency. Remediation activities include oversight to Geoprobe operations, vapor intrusion, geologic and hydrogeologic investigations, geophysical surveys, soil and rock boring and coring, well installations, exploratory boring installation, aquifer tests, and Human health and ecological risk assessments. Main objectives of this project included file review of available background documents and historical data regarding the Site, participation in Community meetings, overseeing the Potentially Responsible Party Remedial Investigation activities on behalf of the U.S. Environmental Protection Agency, coordination with the

U.S. Environmental Protection Agency Contract Laboratory Program, and collection and evaluation of split samples to evaluate Potentially Responsible Party laboratory analytical data.
Project Date: 2010–2014

Compliance Cleanup at 13 Sites, Aberdeen Proving Ground, Maryland; Aberdeen Proving Ground; Project Geologist—Aided in the preparation of the Accident Prevention Plan in accordance with Engineer Manual 385-1-1 for the removal of a remediation system and operations and maintenance activities.
Project Date: December 2013 – January 2014

Maryland Sand, Gravel, and Stone Remedial Construction Oversight Services; Clean Sites Environmental Services; Project Geologist—Project Geologist assisting with excavation oversight, the collection of perimeter air samples and analysis with a gas chromatograph, as well as data entry of analytical results to provide direction to the excavation crews.
Project Date: April-May 2010

Eddie M. Meadows
Site Health and Safety Officer

During his 22 years of experience, Mr. Meadows has been involved in the successful completion of numerous projects and field efforts or phases of those projects, which include management; field oversight; health and safety officer; sample collection and sample custody of soil, water, sediment, and air matrixes; mobile laboratory testing; field screening; report writing, and data reduction/management; basic surveying; and remedial injection activities. His expertise as a field scientist, site manager, and task manager includes field experience, strong understanding of standard operating procedures, and exceptional team oriented people and leadership skills of not only coworkers, but also clients, regulators, and subcontractors.

Education
B.S./Environmental Sciences/1995 (Virginia Tech)

Specialized Training
OSHA 40-Hour Hazardous Waste Operations and Emergency Response Training
OSHA 8-Hour Hazardous Waste Operations Supervisory Training
OSHA 30-Hour Construction Safety and Health Certification
Excavation Safety for Competent Person Training
Confined Space Training
U.S. Army Corps of Engineers Construction Quality Management for Contractors
OSHA 24-Hour Fall Protection for Competent Person Training
Immunoassay Training for field screening of Polycyclic Aromatic Hydrocarbons, Polychlorinated Biphenyls, and TNT
X-Ray Fluorescence Spectrum Analyzer Training
Basic Radiation Worker and Fundamentals of Radiation Training.
Respirator Fit Test
CPR and First Aid Training

Experience
Years with EA: 20 Total Years: 22

Professional Experience

Site Safety and Health Officer—Served as Site Safety and Health Officer for several investigations, removal actions, groundwater monitoring well installations, and construction projects. Duties have included leading tailgate meetings, documenting safety training and monitoring, directing the use of appropriate personal protective equipment, and supervising the implementation of proper decontamination procedures. Has an excellent safety record, including no recordable incidents on those projects where he has served as Site Safety and Health Officer.

SSHO Field Experience Summary (project details below)

- Aberdeen Proving Ground Long-Term Monitoring: April 2017 to Present, intermittent field work, 9 months total
- CLP Hybrid Project; Edgewood, Maryland: July to September 2017, 3 months
- White Swan-Sun Cleaners' Source Area Superfund Site in Wall Township, New Jersey: January to June 2016, intermittent field work, 6 months total
- Fort Meade Base Realignment and Closure Range 17; Fort Meade, Maryland: January to June 2016, 3 months total
- Hamilton Park, Miscellaneous Sites, New Castle, Delaware: July 2014 – October 2015 and August–September 2017, 3 Months total
- Ground Vapor Intrusion; Aberdeen Proving Ground, Aberdeen, Maryland: December 2013 – March 2015, 6 months total
- Andrews Air Force Base Military Munitions Response Program; Andrews Air Force Base Camp Springs, Maryland: April–August 2014, 3 months total
- Ommelanden Huunter Education Training Center; New Castle, Delaware: March 2013 – January 2016, intermittent field work, 4 months total
- Fort Meade System Demolition; Fort Meade, Maryland: February 2013, 1 month total
- Hernwood Sanitary Landfill; Baltimore County; On-call Engineering Services: August 2011 – October 2015, intermittent field work, 4 months total
- Baltimore Gas and Electric Spring Gardens Quarterly Work: March 2015 and September 2015 – December 2016 and January 2017 – present, intermittent field work, 1 months total

- G Street Rad Remedial Investigation at Aberdeen Proving Ground-Other Edgewood Areas: April–August 2011, 5 months total
- Christina Landing Health and Safety Monitoring and Remediation: April 2004 – July 2005, 7 months total
- Maryland State Highway Administration Facility Methyl Tertiary-Butyl Ether Assessment: April–December 2005, 8 months total
- Fort Dix, New Jersey; Numerous Projects: April 1997 – October 2006; intermittent field work, 10 months total

SSHO Project Experience

Aberdeen Proving Ground Long-Term Monitoring; Aberdeen, Maryland; U.S. Army Environmental Command; Site Manager and Site Safety and Health Officer—Responsible for oversight of all aspects of the field effort including both technical and Health and Safety. Scheduled daily activities; coordinated with subcontractors, clients, and EA Project Management. Approximately 110 groundwater, surface water, and sediment samples were collected base-wide and relinquished for laboratory analysis specific to each site and with strict adherence to sample custody standard operating procedures. Regulations and quality control specifications were followed and implemented as required. Daily and weekly paperwork was completed in a timely fashion, and the field work effort was completed efficiently and effectively. Health and safety duties include ensuring proper use of PPE, conducing environmental monitoring, and completing H&S documentation as required.
Project Date: April 2017 – Present

CLP Hybrid Project; Edgewood, Maryland; City, Light, and Power, Inc.; Site Manager and Site Safety and Health Officer—Responsible for oversight of all aspects of the field effort including both technical and Health and Safety. Scheduled daily activities; coordinated with subcontractors, clients, unexploded ordnance support, and EA Project Management. Approximately 150 soil samples were collected via hand auger base-wide and relinquished for laboratory analysis specific to each site and with strict adherence to sample custody standard operating procedures. Regulations and quality control specifications were followed and implemented as required. Daily and weekly paperwork was completed in a timely fashion, and the field work effort was completed efficiently and effectively. Health and safety duties included ensuring proper use of PPE and conducted environmental monitoring.
Project Date: July–September 2017

Site Safety and Health Officer and Competent Person (Alternate); White Swan-Sun Cleaners' Source Area Superfund Site in Wall Township, New Jersey—Alternate Site Safety and Health Officer for site activities including asbestos assessment and abatement, respiratory protection and monitoring, tree and vegetation removal, excavation of surface soils with heavy equipment, asphalt removal, vegetation clearance and tree felling, traffic protection, well installation and development with heavy equipment, investigation-derived waste management and assessment, air monitoring, fall protection, ladder use, permanent fence installation, contaminated media sampling, heat and cold stress monitoring, exchange of granular activated carbon, and high pressure air sparge and soil vapor extraction system installation and monitoring for a chlorinated solvent-contaminated site. Responsibilities included:

- Perform SOH oversight during above activities as specified in Engineer Manual 385-1-1 including heavy equipment use, inspections, and corrective actions
- Perform SOH oversight during Rotosonic well installation activities, heavy equipment usage, high-pressure well development activities, and sampling groundwater
- Perform SOH oversight during oversized load equipment delivery and site operations trailer delivery and exchange of granular activated carbon (used and unused)
- Performed SOH oversight of the Fall Protection and Prevention Program during carbon-change out and usage of the aerial lift by qualified persons (JLG Model 260 MRT; Harness Model 19F395)
- Assisted with onsite quality control operations following quality control specifications
- Completion of audit process and near miss investigations
- Perform daily safety briefings consistent with the Accident Prevention Plan and Site Safety and Health Plan for site physical/chemical/biological/ and radiological hazards
- Ensure site workers abided by Respiratory Protection Program and followed respirator-use procedures
- Conduct daily site safety and health inspections for job zones
- Prepare safety and health compliance memoranda

- Develop, implement, and ensure compliance with the Accident Prevention Plan
- Calibrate and document calibration of monitoring and/or screening equipment prior to use
- Direct, distribute, and inspect appropriate personal protective equipment to site personnel (Level D, Mod Level D, and Level C)

Project Date: January–June 2016

Fort Meade Base Realignment and Closure Range 17; Fort Meade, Maryland; U.S. Army Corps of Engineers–Baltimore Corps; Health and Safety Officer—Responsible for oversight of all onsite health and safety oversight. Implemented the Accident Prevention Plan and Site Safety and Health Plan, and conducted daily tailgate meetings. Reviewed applicable activity hazard analyses as project requirements dictated; wrote new activity hazard analyses onsite and submitted them as an addendum for proposed work that were not addressed in previously submitted activity hazard analyses; completed Accident and Near Miss forms as required; and all other daily health and safety paperwork including but not limited to health and safety tailgate meeting log, Site Entry and Exit log, Visitors Log, Exposure Hours log, Environmental Monitoring Record, Health and Safety Activity reports, and Daily Heavy Equipment Vehicle, Hand and Power Tool, First Aid, Eyewash, and Fire Extinguisher checklists.
Project Date: July 2015 – January 2016

Hamilton Park, Miscellaneous Sites, New Castle, Delaware; Delaware Department of Natural Resources and Environmental Conservation; Laborer, Site Manager, Health and Safety Officer—Worked in various roles on several properties as the project required. All roles lead to being responsible for contributing to the safe and successful soil excavation and removal of contaminated soil at the individual properties site-wide.
Project Date: July 2014 – October 2015 and August–September 2017

Ground Vapor Intrusion; Aberdeen Proving Ground, Aberdeen, Maryland; U.S. Army Environmental Command; Task Manager, Site Manager, Health and Safety Officer—Responsible for oversight of all aspects of the field effort. Scheduled daily activities; coordinated with subcontractors, clients, and EA Project Management. Approximately 400 subsurface soil vapor samples were collected via 8-hour summa canisters in approximately 90 buildings base-wide; was responsible for this coordination effort with building tenants and/or custodians while keeping Aberdeen Proving Ground's chain of command intact. Daily activities included but were not limited to the following: scheduling, sampling that included preparation work, and drilling. Tracer testing (leak tests), recording pressure readings, and surface completion of tile, carpet, or concrete where holes were drilled inside the individual buildings, sample custody, and scheduling retests where applicable, completed daily paperwork as required, and also acted as the Site Safety and Health Officer.
Project Date: December 2013 – March 2015

Andrews Air Force Base Military Munitions Response Program; Andrews Air Force Base Camp Springs, Maryland; U.S. Army Corps of Engineers–Omaha District; Field Scientist and Site Safety and Health Officer—Filled in as the project required for either the full-time sampler, the Site Safety and Health Officer, and quality assurance/quality control analysis on sample locations; collected soil samples; analyzed sampled for metals via x-ray fluorescence; downloaded field screening results; performed sample custody for analytical samples via laboratory; managed progress of sampling grids; used Global Positioning System on sample grids; informed subcontractors where to dig and/or re-dig; acted as Site Safety and Health Officer as needed, including the completion of all daily U.S. Army Corps of Engineers required paperwork; and performed quality assurance/quality control analysis on grid work for samples collected by cross referencing the samples collected spreadsheet versus the completed figures for the individual grids.
Project Date: April–August 2014

Ommelanden Huunter Education Training Center; New Castle, Delaware; Delaware Department of Natural Resources and Environmental Control; Task Manager/Site Manager/Health and Safety Officer—Responsible for oversight of all aspects of the field effort. Scheduled daily activities; coordinated with subcontractors, clients, and EA's Project Manager; utilized Global Positioning on grids including approximately 400 sample locations; completed sample collection of surface soil, subsurface soil, surface water, and sediment samples; performed sample custody; executed field screening on samples, determined delineation requirements, reduced data, determined locations for laboratory confirmation samples; completed daily paperwork for sampling effort and Health and Safety requirements. Through challenging conditions such as wetland soil and subsurface soil samples, surface water

samples, and sediment samples that were heavily tidally influenced, outperformed the scope of work required while still completing the field effort on time and under budget. Assisted in the writing portions of the final report.
Project Date: March 2013 – January 2016

Fort Meade System Demolition; Fort Meade, Maryland; Health and Safety Officer—Performed duties as needed for the project requirements while acting as the Site Safety and Health Officer for the project. Completed daily paperwork, held tailgate meetings addressing possible hazards specific for the expectations of individual day's planned activities, coordinated with EA project management, subcontractors and clients, and ensured all site worker's certifications and training was current.
Project Date: February 2013

Hernwood Sanitary Landfill; Baltimore County; On-call Engineering Services; Field Scientist/EA Team Leader/Site Manager/Health and Safety Officer—Performed duties as needed including but not limited to the following: injection well installation, coordinating with subcontractors and clients as necessary, acted as a liaison between EA project management and subcontractors/clients, health and safety officer, sample collection and custody of groundwater, surface water, sediment, and air matrixes, pilot study in support of the full-scale groundwater remediation effort, and active amendment injections during and for the full-scale groundwater remediation effort.
Project Date: August 2011 – October 2015

Baltimore Gas and Electric Spring Gardens Quarterly Work; Task Manager/Project Geologist/Site Safety and Health Officer—Performed dense and light non-aqueous phase liquid recovery, collected offsite groundwater samples, managed data, wrote quarterly reports, updated the database, and interacted with subcontractors and client throughout the entire process.
Project Date: May 2003 – March 2015 and September 2015 – December 2016 and January 2017 – present

G Street Rad Remedial Investigation at Aberdeen Proving Ground-Other Edgewood Areas; Field Team Leader and Health and Safety Officer—Performed daily oversight of subcontractors and coworkers for Rad contamination investigation and performed all health and safety monitoring not within the radiological or unexploded ordnance concerns. Determined where to collect soil and/or water samples, performed sample custody, interacted with client, and acted as liaison between field crew and the Project Manager.
Project Date: April–August 2011

Christina Landing Health and Safety Monitoring and Remediation; Health and Safety Officer— Conducted health and safety oversight, oversaw remediation and excavation of petroleum-impacted soils, collected soil, groundwater, and air samples to confirm remaining areas were below human health risk criteria for future development of the area.
Project Date: April 2004 – July 2005

Maryland State Highway Administration Facility Methyl Tertiary-Butyl Ether Assessment; Site Manager and Health and Safety Officer —Performed oversight for monitor well installation, collected groundwater and soil samples to characterize contamination at the site as a result of possible leaking underground storage tanks. Performed health and safety monitoring throughout the duration of the project.
Project Date: April–December 2005

Fort Dix, New Jersey; Numerous Projects; Field Scientist/Site Manager/Scientist/Health and Safety Officer — Coordinated the quarterly field sampling efforts with the client and subcontractors; collected groundwater, surface water, and sediment samples; oversaw sample custody preparation; and preformed report writing.
Project Date: April 1997 – October 2006

Meadows Safety and Health Certifications

1.	Cover Page and Resume		
2.	40-Hour HAZWOPER Original	(No Expiration)	(07/10/1994)
3.	8-HR Supervisor	(No Expiration)	(04/25/2008)
4.	30-HR Construction	(No Expiration)	(05/14/2009)
5.	8-HR Refresher for 40hrHAZWOPER and Bloodborne Pathogens	(Annual)	(03/23/2019)
6.	First Aid/CPR	(Biannual)	(12/08/2019)
7.	Bloodborne Pathogens Workplace	(Annual)	(12/08/2018)
8.	Medical Surveillance	(Annual)	(01/09/2019)
9.	Certification for Respirator Use	(Annual)	(01/09/2019)
10.	Respirator Fit Test Documentation	(Annual)	(01/09/2019)

Original 40-Hour HAZWOPER

(Does Not Expire)

New Environment, Inc.

This is to certify that

Eddie Meadows

has satisfactorily completed NEI's

HAZWOPER

[29CFR1910.120]

40-Hour Worker Program

7/10/1994
Date

Timothy E. Smith

Baltimore, MD
Location

800.732.3073

33828
Student ID Number

8-Hour Supervisor Training

(Does Not Expire)

EA Engineering, Science, And Technology, Inc.

Certificate of Training

PRESENTED TO

Eddie Meadows

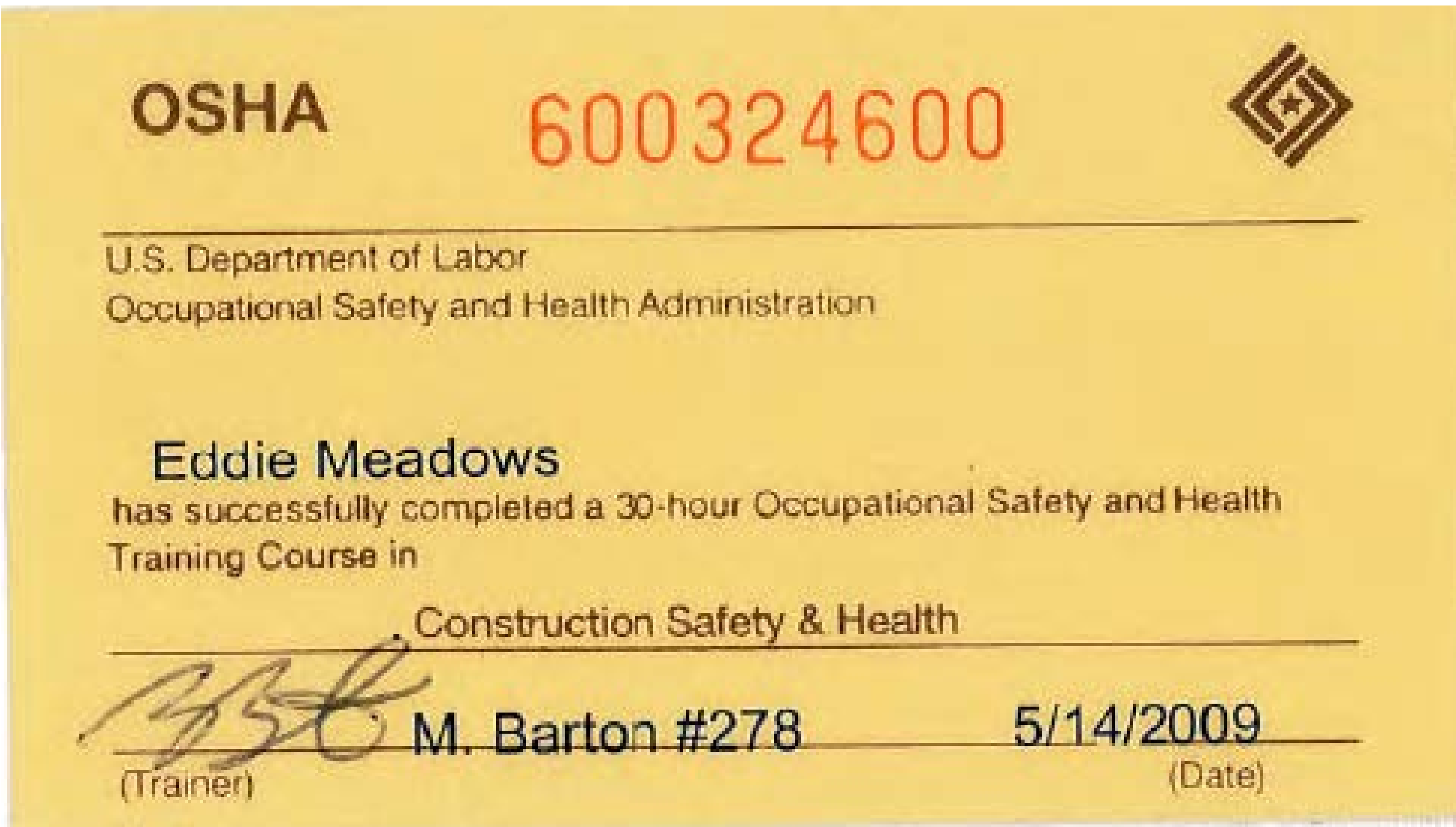
FOR COMPLETION OF

8-Hour HAZWOPER Supervisor Training Per 29 CFR 1910.120

25 April 2008

Peter Garger, CIH

30-Hour Construction
(Does Not Expire)



OSHA 600324600

U.S. Department of Labor
Occupational Safety and Health Administration

Eddie Meadows
has successfully completed a 30-hour Occupational Safety and Health Training Course in

Construction Safety & Health

M. Barton #278 (Trainer)

5/14/2009 (Date)

8-Hour HAZWOPER Refresher
(Expires 03/23/2019)

EA Engineering, Science, and Technology, Inc., PBC

Certificate of Training

Presented to

Eddie Meadows

For Completion of

8 Hour HAZWOPER Refresher Training IAW 29 CFR 1910.120 and Blood-Borne Pathogen Training IAW 29 CFR 1910.130

March 23, 2018

Peter Garger

Peter Garger, CIH, CSP

EA ACADEMY

First Aid and Cardiopulmonary Resuscitation (Expires 12/08/2019)

CERTIFICATION CARD

BasicPlus

CPR, AED, and First Aid for Adults

Eddie Meadows

has successfully completed and competently performed the required knowledge and skill objectives for this program.

GUIDELINES

MEDIC First Aid

Luis M. Diaz

Authorized Instructor (Print Name)

173979

Registry No.

12/08/2017

Class Completion Date

12/08/2019

Expiration Date

240-446-4366

Training Center Phone No.

173978

Training Center I.D.

This card certifies the above named individual has successfully completed the required objectives and hands-on skill evaluations to the satisfaction of a currently authorized MEDIC First Aid Instructor. This program conforms to the 2015 AHA Guidelines Update for CPR and ECC and the 2015 AHA and ARC Guidelines Update for First Aid. Expiration date may not exceed two years from month of class completion.

Bloodborne Pathogens in the Workplace
(Expires 12/08/2018)

CERTIFICATION CARD

Bloodborne Pathogens
in the Workplace

Eddie Meadows

has successfully completed the course requirements
for the Bloodborne Pathogens in the Workplace Program.

G2015 GUIDELINES

hsi Health & Safety Institute

MEDIC First Aid

Luis M. Diaz
Authorized Instructor (Print Name)

173979
Registry No.

12/08/2017	12/08/2018
Class Completion Date	Expiration Date
240-446-4366	173978
Training Center Phone No.	Training Center I.D.

This card certifies the holder has completed the course requirements as provided by a currently authorized MEDIC First Aid Instructor. Certification does not guarantee future performance, or imply licensure or credentialing. Course content assists in satisfying the information and training requirements of the U.S. Department of Labor (OSHA 29 CFR 1910.1030). Certification period may not exceed 12 months from class completion.

Medical Surveillance
(Expires 01/09/2019)

ALL ONE HEALTH

Medical Release for Medical Surveillance

Employee's Name:	Meadows, Eddie
Employee Number:	65911
Birth Date:	1/6/1972 12:00:00 AM
Company:	EA Engineering Science & Technology, Inc
Company Location:	Edgewood, MD
Date of Exam:	12/21/2017 12:00:00 AM
Exam Location:	Occupational Medical Services - Belcamp
	Belcamp, MD
Medical Surveillance:	Medical Surveillance - Periodic Exam

I have reviewed the services performed on the above named individual per OSHA regulations and in my opinion,

I have not detected any medical condition which would place the employee at increased risk of health impairment from work.

Other Comment: CERTIFICATION FOR RESPIRATOR USE EXPIRES 12/21/2017

I have informed the employee of the results of the examination and any medical conditions which require further examination or treatment.

For asbestos examinations: The above employee has been informed of the health risks associated with smoking and asbestos exposure.

Dr. Fred Kohanna MD	Fred Kohanna, MD	1/9/2018 10:47:55 AM
Authorized Physician	Authorized signature	Date

CVID: 2096661

Med ResultID: 58728855

Certification for Respirator Use (Expires 01/09/2019)

ALLONE HEALTH

Certification for Respirator Use
29 CFR 1910.134

Employee's Name:	Meadows, Eddie
Employee Number:	65911
Birth Date:	01/06/1972
Company:	EA Engineering Science & Technology, Inc
Company Location:	Edgewood, MD
Date of Exam:	12/21/2017
Exam Location:	Occupational Medical Services - Belcamp
	Belcamp, MD

I have reviewed the examination of the above named individual and I certify that this employee is physically capable of using all types of respiratory protection.

Prescription eyeglasses and beards cannot be worn with all types of respirators. Any interference with a mask seal is not acceptable. Contact lenses should not be worn while working with acrylonitrile, 1, 2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, and 4,4' - methylene dianiline.

Dr Fred Kohanna	Fred Kohanna, MD	1/9/2018 10:48:30 AM
Authorized signature	Authorized signature	Date

The above employee has been notified of this determination

CVID: 2096661 | Medical ResultID: 58728865

Respirator Fit Test Documentation (Expires 1/09/2019)

RESPIRATOR FIT TEST RECORD

Name: Eddie Meadows
Organization: EA Engineering
Fit Test Date: 8/1/18

Medical Clearance Date: 1/9/18

Corrective Lenses Needed Yes _ No _

Briefed on fundamental principles of respiratory protection, use selection, inspection, cleaning, maintenance, and storage of equipment Yes _ No _

~~Isoamyl acetate odor recognition. Pass _ Fail _~~
Irritant smoke sensitivity. Pass _ Fail _

	Respirator 1	Respirator 2	Respirator 3
Equipment Type	Full Face	Half Face	
Manufacturer	MSA	MSA	
Model	M2 C1	M4 C2	
Size	medium	medium	
Facepiece composition (Rubber/Silicone)	silicone	silicone	

Test performed	Respirator 1	Respirator 2	Respirator 3
Negative Pressure Test	Pass _ Fail _	Pass _ Fail _	Pass _ Fail _
Positive Pressure Test	Pass _ Fail _	Pass _ Fail _	Pass _ Fail _
~~Isoamyl Acetate Test~~	~~Pass _ Fail _~~	~~Pass _ Fail _~~	~~Pass _ Fail _~~
Irritant Smoke Test	Pass _ Fail _	Pass _ Fail _	Pass _ Fail _

The individual named above has been fit tested according to procedures specified according to EA Engineering, Science, and Technology Safety and Health protocols. This qualitative fit test protocol has been adapted from OSHA 29 CFR 1910 and 29 CFR 1926.

Bill Harvey	[signature]	8/1/18
Examiner's Name	Examiner's Signature	Date
Eddie Meadows	[signature]	8/1/18
Employee's Name	Employee's Signature	Date

Respirator Fit Test Record.

Jeffrey Smith
Site Safety and Health Officer (SSHO)

Qualifications

Education
B.S., Towson State University; Physics; 1990

Specialized Training
OSHA 40-Hour Hazardous Waste Operations Training
OSHA 8-Hour Supervisor
OSHA 30-hour Construction Safety Training
Confined Space Training
Competent Person Trenching/Construction

Experience
Years with EA: 21 Total Years: 24

With over 5 years of experience as an SSHO on construction and environmental sites and 24 years of experience overall, Mr. Smith provides health and safety responsibilities on sites involving excavations, heavy equipment operations, remediation system installation and environmental sampling. He is responsible for conducting daily health and safety meetings, ensuring Accident Prevention Plan (APP) compliance, and compiling daily quality control reports. Mr. Smith is trained and experienced in performing and demonstrating calibration of monitoring equipment; providing health and safety oversight during excavations, and/or environmental sampling activities; providing on-site training relating to project safety; applying Site Safety and Health Plans; implementation of emergency procedures; performing air monitoring; and selecting, wearing, and training others regarding personal protective equipment (PPE). Mr. Smith has also conducted site inspections to evaluate work conditions for potential job site hazards, investigating and reporting accidents injuries, and occupational illnesses, documentation via standard form 3394, daily safety tailgate meetings, investigating reports of hazardous conditions and taking actions as appropriate to remedy the situation. He has substantial experience in ensuring proper use, calibration, and maintenance of safety and monitoring equipment, ensuring air sampling/monitoring was properly performed, and monitoring/oversight of subcontractors. Responsible for implementing health and safety rules and regulations as dictated by U.S. Army Corps of Engineers 385-1-1Safety Manual as well as other state and federal regulations.

SSHO; Puchack Well Field Superfund Site in Pennsauken, NJ (35+ months; November 2011 – Present; Excavation and Trenching 12 Months; November 2012-November 2013):
SSHO for site activities including sampling of impacted groundwater, **excavation and trenching, heavy equipment operation**, and operations and maintenance of an injection system. Implemented APP and provided health and safety oversight for 20-30 subcontractors and 10- 20 EA employees simultaneously.

Responsibilities included:

- Performed environmental and **construction health and safety oversight** during all site activities including **excavation and trenching**
- Presented **daily safety briefings** that included awareness training for site physical/chemical/ biological hazards
- Calibrated and document calibration of monitoring and/or screening equipment prior to use (PID/YSI)
- Performed **air monitoring** for confined space entry
- Developed, implemented, and ensured compliance with the APP
- Develop new **activity hazard analyses (AHAs)** when conditions changed and new work activities were required
- Conducted site inspections to evaluate work conditions for job zones
- Prepared health and safety compliance memoranda
- Directed, distributed, and inspected appropriate PPE to site personnel
- Conducted **daily heavy equipment inspections** (excavator, loader, skid steer and dozer)
- Provided **accident and near miss investigation** and reporting via SF3394
- Maintained and enforced appropriate PPE use
- No lost time incidents were recorded over **46,000+ man-hours of exposure**.

SSHO; Aberdeen Proving Ground in Aberdeen, MD (10 months; January 2011-October 2011):
SSHO for **construction activities** including the construction and disposal of a soil stockpile approximating 100,000 cubic yards under BRAC (Base Realignment and Closure). Health and safety oversight included implementation of health & safety plan site inspections to evaluate work conditions for potential job site hazards, conducting daily safety tailgate meetings, and ensuring use of proper personal protective equipment PPE.

Responsibilities included:

- Performed **construction health and safety oversight** during heavy equipment operations including excavators and loaders
- Presented **daily safety briefings** that included awareness training for site physical/chemical/ biological hazards
- Calibrated and documented calibration of dust monitoring and/or screening equipment prior to use
- Developed, implemented, and ensured compliance with the APP
- Conducted site inspections to evaluate work conditions for job zones
- Conducted **daily heavy equipment inspections**
- Directed, distributed, and inspected appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

SSHO; Atlantic Woods Industries Superfund Site in Portsmouth, Virginia (12 Months; January 2010-December 2010):

SSHO for site **construction activities** including the construction of two soil containment berms for the disposal of locally dredged hazardous materials.

Responsibilities included:

- Performed **construction health and safety oversight** during all site activities including excavation, loading and dumping
- Presented **daily safety briefings** that included awareness training for site physical/chemical/ biological hazards
- Calibrated and document calibration of monitoring and/or screening equipment
- Developed, implemented, and ensured compliance with the APP
- Conducted **site inspections** to evaluate work conditions for job zones
- Conducted **daily heavy equipment inspections**
- Conducted **accident investigation** and reporting
- Directed, distributed, and inspected appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

SSHO; Remedial Action, Old Dump on Woodrest Creek, Aberdeen Proving Ground, Aberdeen Areas, Maryland (12 Months; January 2009-December 2009):

SSHO site **construction activities** involving the construction of a 4-acre soil cap. Responsible for the overall health and safety of multiple contractors and EA employees during the installation of a soil cap, and stabilization of over 1,000–ft of shoreline. Performed continuous air monitoring and advised of dust suppression during construction activities.

Responsibilities included:

- Performed **construction health and safety oversight** during all site activities including soil dumping, loading and dozing
- Presented **daily safety briefings** that included awareness training for site physical/chemical/ biological hazards
- Calibrated and used **dust monitoring equipment**
- Developed, implemented, and ensured compliance with the APP
- Conducted **site inspections** to evaluate work conditions for job zones
- Conducted **daily heavy equipment inspections**
- Conducted **accident investigation** and reporting
- Directed, distributed, and inspected appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

SSHO; Remedial Design and Soil Removal Action, Known Distance Range Site 30B, Aberdeen Proving Ground, Aberdeen, Maryland (12 Months; January 2008-December 2008):

SSHO for site **construction and investigation activities** including lead contamination delineation, heavy equipment excavation of lead impacted soil, soil screening, sample collection, soil stabilization, loading contaminated soil for offsite disposal and site restoration/grading The project included removal, stabilization, and offsite disposal of 16,000 tons of soil. Soil was screened prior to stabilization, recovering/recycling 13 tons of bullets/fragments. Soil was stabilized for offsite use as daily landfill cover. Site activities also involved identification and inspection of debris, certification of items as munitions debris or cultural debris, and shipping for final disposal (i.e., landfill, recycling).

Responsibilities included:

- Performed **construction health and safety oversight** during all site construction activities including excavation, loading, screening, stabilization, and hauling.
- Presented **daily safety briefings** that included awareness training for site hazards
- Implemented, and ensured compliance with the APP/SSHP
- Conducted **site inspections and accident investigation** to evaluate work conditions and accident causes
- Performed **initial and daily heavy equipment inspections**
- Directed, distributed, and inspected appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

SSHO; Riverfront Development Corporation, Wilmington, Delaware, Christina Landing Voluntary Cleanup Program; (12 Months, May 2006 – May 2007)

Provided **health and safety oversight during a construction activities** conducted under the voluntary cleanup program at a former brownfield site in Wilmington, Delaware. The remedial actions included soil excavation and hot spot removal (30,000 yd^3), onsite containment, soil sampling and the installation of vapor barriers and venting systems.

Responsibilities included:

- Performed **construction health and safety oversight** during all site construction activities including excavation, loading, screening, stabilization, and installation of vapor controls.
- Calibrated and documented calibration of monitoring and/or screening equipment
- Performed **air monitoring** for confined space entry and trenching activities
- Presented **daily safety briefings** that included awareness training for site hazards
- Implemented, and ensured compliance with the APP/SSHP
- Conducted **site inspections and accident investigation** to evaluate work conditions for job zones
- Directed, distributed, and inspected appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

SSHO; Soil Remediation, St. Georges Bridge, Delaware; U.S. Army Corps of Engineers, Baltimore, Maryland (12 Months; March 2000-March 2001):

SSHO for **site construction activities** including sampling of lead-based paint impacted soil and the excavation and disposal of 1,000+ yd3 of lead contaminated soil.

Responsibilities included:

- Performed **construction health and safety oversight** during all site construction activities including excavation, loading and site restoration
- Presented **daily safety briefings** that included awareness training for site hazards
- Implemented, and ensured compliance with the APP/SSHP
- Conducted **site inspections and accident investigations** to evaluate work conditions and accident causes
- Performed **initial and daily heavy equipment inspections**
- Conducted **air monitoring** for dust and ensure dust suppression measures were used
- Directed, distributed, and inspectd appropriate PPE to site personnel
- Maintained and enforced appropriate PPE use

Other Health and Safety Related Activities

Field Scientist; Remedial Action Mold Abatement, State Highway Administration, Maryland; (1 Week; September 2005)

Field scientist for remedial actions including removal of mold impacted drywall.

- Performed drywall removal and disposal in **Level C**
- Supervised personnel in **Level C**
- Performed **fit test** for personnel in Level C
- Performed **weekly inspections** of individual respirators and respirator storage

- Performed **daily respirator and respirator cartridge inventory inspections**

Field Scientist; Phase I and II Environmental Site Assessments, Former Lake Ontario Ordnance Works, Niagara County, New York;
(8 Months; Field Scientist June-September 1998 and June-September 2000)

Field scientist during the site investigation of process areas and underground utility lines of the former trinitrotoluene (TNT) plant and subsequent Department of Defense (DoD) facility. Site activities included soil and groundwater sampling.

- Performed soil and groundwater sampling in **Level C**
- Performed **weekly inspection** of individual respirators and respirator storage
- Performed **daily respirator and respirator cartridge inventory inspections** Performed initial and daily site health and safety inspections

Field Scientist; Environmental Sampling, Ellsworth Air Force Base, South Dakota;
(2 Weeks; May 1994)

- Performed soil sampling in **Level C**
- Performed **inspection** of individual respirators and respirator storage

Performed **daily respirator and respirator cartridge inventory inspections**

Field Scientist; Confined Space Tank Cleaning/Sampling, Prince George's County, Maryland;
(1 Week; June 1998)

- Performed soil sampling in **Level C** in confined space
- Performed **inspections** of individual respirators and respirator storage
- Performed **daily respirator and respirator cartridge inventory inspections**

General Project Experience

Environmental Remediation—Served as site construction manager, health and safety officer, and quality control officer for landfill capping operation on Aberdeen Proving Ground. Duties included wetlands creation and the planting of 1,200+ native trees and shrubs.

Field Management—Served as field manager and health and safety officer for installation of wildlife protection measures at all downrange areas of Aberdeen Proving Ground. Interacted with Aberdeen Proving Ground Safety Department during the movement of high voltage bucket trucks in swampy conditions in an effort to reach high voltage lines and install bird diverter cards, and worked with high voltage crews to obtain electrical outages on 35-kV lines.

Environmental Impact/Risk Assessment—Served as field manager and health and safety office for five Aberdeen Proving Ground sites for the removal of several hundred cubic yards of contaminated soil. Coordinated and worked with bomb disposal technicians during all excavation activities to remove all soils in a safe manner.

Petroleum Hydrocarbon Investigation and Remediation—Extensive experience in the installation and operation of various remedial technologies for the remediation of petroleum hydrocarbons. Has performed operation and maintenance at more than 75 remediation sites to utilize groundwater pump-and-treat, skimming, air sparging, soil vapor extraction, bioventing, and dual-phase extraction remediation systems for the recovery of petroleum hydrocarbons. Extensive experience in the troubleshooting and maximizing performance of these remedial systems.

Various Projects at Aberdeen Proving Ground; Aberdeen Proving Ground, Maryland—Involved in numerous tasks, serving as a site manager, and health and safety officer. Many of the projects at the 70,000-acre Aberdeen Proving Ground installation have involved explosive and/unexploded ordnance avoidance and removal. Health and safety duties included oversight, implementation of health & safety plan, site inspections to evaluate work conditions for potential job site hazards, daily safety tailgate meetings, ensuring proper use/calibration and maintenance of safety and monitoring equipment, and ensuring air sampling/monitoring was properly performed. ***(1994 – Present)***

Level D Field Support – Site Characterization in Other Edgewood Areas; Aberdeen Proving Ground, Maryland; Field Scientist—Activities completed include collection of surface soil samples and removal of potential sources of contamination from the ground surface within several study areas within the Other Edgewood Areas. Potential sources included various types of munitions and miscellaneous items (such as deteriorated drums and metallic items);

including a former munitions disposal pit where more than 6,500 rounds were recovered, resulting in a Time Critical Removal Action. ***Project Dates: 2007 – 2008***

1400 Lancaster Street, LLC, Baltimore City, Maryland - Hexavalent Chromium Remediation —Served as health and safety officer for the redevelopment of Brownfields along the Baltimore City waterfront. The property was located adjacent to the former Allied Signal plant, which processed chrome-plating materials from chromium ore. Duties included monitoring construction workers in the breathing zone and site perimeter during the removal of hazardous hexavalent chromium impacted soil. ***Project Dates: 2002-2004***

Lake Ontario Ordnance Works; U.S. Army Corps of Engineers–Baltimore; Sampling Supervisor—Served as site manager, and health and safety officer directing 10+ EA employees and 15+ subcontractors during monitoring well installation and hazardous material removal while interacting with both public and private companies and land owners. Served as heavy equipment operator for clearing groundwater survey grid and hazardous waste test trenching and locating. ***Project Dates: 1998–2000***

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Smith Safety and Health Certifications

1.	Cover Page and Resume		
2.	40-Hour HAZWOPER Original	(No Expiration)	(04/23/1993)
3.	30-HR Construction	(No Expiration)	(05/14/2009)
4.	8-HR Supervisor	(No Expiration)	(04/25/2008)
5.	8-HR HAZWOPER Refresher	(Annual)	(03/28/2015)
6.	First Aid/CPR	(Biannual)	(12/8/2019)
7.	Blood-Borne Pathogen	(Annual)	(12/8/2018)
8.	Medical Surveillance	(Annual)	(2/9/2019)
9.	Respirator Use	(Annual)	(2/9/2019)
10.	Fit Test Certification	(Annual)	(05/21/2015)

Original 40-Hour HAZWOPER

(Does Not Expire)

TRAINING ▲ INFORMATION ▲ SERVICES ▲ INC

CERTIFICATE OF COMPLETION

This is to certify that

JEFFREY B. SMITH

has successfully completed

HAZARDOUS MATERIALS SITE WORKER COURSE (40-HOUR)

at

HAZMAT T.I.S.I.; COLUMBIA, MARYLAND

Chief Operating Officer

Chief Executive Officer

April 19 - 23, 1993
40S-9304B

OSHA 30-HR Construction

(Does Not Expire)

OSHA 600324598

U.S. Department of Labor
Occupational Safety and Health Administration

Jeffrey Smith
has successfully completed a 30-hour Occupational Safety and Health Training Course in

Construction Safety & Health

M. Barton #278 5/14/2009

(Trainer) (Date)

8-Hour Supervisor Training

(Does Not Expire)

EA Engineering, Science,
And Technology, Inc.

Certificate of Training

PRESENTED TO

Jeff Smith

FOR COMPLETION OF

**8-Hour HAZWOPER
Supervisor Training
Per 29 CFR 1910.120**

25 April 2008

Peter Garger, CIH

8-Hour HAZWOPER Refresher

(Expires 03/28/2016)

EA Engineering, Science, and Technology, Inc., PBC

Certificate of Training

Presented to

Jeff Smith

For Completion of

8 Hour HAZWOPER Refresher Training IAW 29 CFR 1910.120 and Blood-Borne Pathogen Training IAW 29 CFR 1910.130

March 23, 2018

Peter Garger, CIH, CSP

First Aid/CPR

(Expires 12/08/2019)

Blood Borne Pathogens
(Expires 12/08/2018)

CERTIFICATION CARD

Bloodborne Pathogens
in the Workplace

Jeff Smith

has successfully completed the course requirements for the Bloodborne Pathogens in the Workplace Program.

GUIDELINES 2015 | hsi Health & Safety Institute | MEDIC First Aid

Luis M. Diaz
Authorized Instructor (Print Name)

173979
Registry No.

12/08/2017 Class Completion Date	12/08/2018 Expiration Date
240-446-4366 Training Center Phone No.	173978 Training Center I.D.

This card certifies the holder has completed the course requirements as provided by a currently authorized MEDIC First Aid Instructor. Certification does not guarantee future performance, or imply licensure or credentialing. Course content assists in satisfying the information and training requirements of the U.S. Department of Labor (OSHA 29 CFR 1910.1030). Certification period may not exceed 12 months from class completion.

Medical Surveillance
(Expires 2/9/2019)

ALLONE HEALTH

Medical Release for Medical Surveillance

Employee's Name:	Smith, Jeffrey B.
Employee Number:	88890
Birth Date:	9/30/1963 12:00:00 AM
Company:	EA Engineering Science & Technology, Inc
Company Location:	Edgewood, MD
Date of Exam:	2/5/2018 12:00:00 AM
Exam Location:	Occupational Medical Services - Belcamp
	Belcamp, MD
Medical Surveillance:	Medical Surveillance Exam - Annual

I have reviewed the services performed on the above named individual per OSHA regulations and in my opinion,

I have not detected any medical condition which would place the employee at increased risk of health impairment from work.

DOT Result: DOT Card Granted / Renewed: Yes ;New card expires: 02/05/2020

Other Comment:

I have informed the employee of the results of the examination and any medical conditions which require further examination or treatment.

For asbestos examinations: The above employee has been informed of the health risks associated with smoking and asbestos exposure.

Dr. Fred Kohanna MD	Fred Kohanna, MD	2/9/2018 5:49:32 PM
Authorized Physician	Authorized signature	Date

CVID: 2118957

Med ResultID: 59286163

Respirator Certification of Use
(Expires 2/9/2019)

ALLONE HEALTH

Certification for Respirator Use
29 CFR 1910.134

Employee's Name:	Smith, Jeffrey B.
Employee Number:	88890
Birth Date:	09/30/1963
Company:	EA Engineering Science & Technology, Inc
Company Location:	Edgewood, MD
Date of Exam:	02/05/2018
Exam Location:	Occupational Medical Services - Belcamp
	Belcamp, MD

I have reviewed the examination of the above named individual and I certify that this employee is physically capable of using all types of respiratory protection.

Other:
CERTIFICATION FOR RESPIRATOR USE EXPIRES 2/5/2019

Prescription eyeglasses and beards cannot be worn with all types of respirators. Any interference with a mask seal is not acceptable. Contact lenses should not be worn while working with acrylonitrile, 1, 2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, and 4,4' - methylene dianiline.

Dr Fred Kohanna	Fred Kohanna, MD	2/9/2018 5:49:42 PM
Authorized signature	Authorized signature	Date

The above employee has been notified of this determination

CVID: 2118957

Medical ResultID: 59286173

Respirator Fit Test
(Expires 05/21/2016)

RESPIRATOR FIT TEST RECORD

Name: Jeff Smith
Organization: EA Engineering
Fit Test Date: 05/21/15

Medical Clearance Date: 04/04/15

Corrective Lenses Needed Yes _ No ✓

Briefed on fundamental principles of respiratory protection, use selection, inspection, cleaning, maintenance, and storage of equipment Yes ✓ No _

Isoamyl acetate odor recognition. ~~Pass _ Fail~~ _
Irritant smoke sensitivity. Pass ✓ Fail _

	Respirator 1	Respirator 2	Respirator 3
Equipment Type	Full Face		
Manufacturer	MSA		
Model	M2C4		
Size	M		
Facepiece composition (Rubber/Silicone)	Rubber		

Test performed	Respirator 1	Respirator 2	Respirator 3
Negative Pressure Test	Pass ✓ Fail _	Pass _ Fail _	Pass _ Fail _
Positive Pressure Test	Pass ✓ Fail _	Pass _ Fail _	Pass _ Fail _
Isoamyl Acetate Test	~~Pass _ Fail~~ _	Pass _ Fail _	Pass _ Fail _
Irritant Smoke Test	Pass ✓ Fail _	Pass _ Fail _	Pass _ Fail _

The individual named above has been fit tested according to procedures specified according to EA Engineering, Science, and Technology Safety and Health protocols. This qualitative fit test protocol has been adapted from OSHA 29 CFR 1910 and 29 CFR 1926.

Anna-Lisa Marcum	[illegible]	05/21/15
Examiner's Name	Examiner's Signature	Date
[illegible]	JEFFREY SMITH	05/21/15
Employee's Name	Employee's Signature	Date

JOHN D. MARLOWE

Graduated Basic EOD/UXO School: Canadian EOD Specialty Course, OCT 1979
40 Hour HAZWOPER: NOV 1996
30 Hour Construction Safety: SEP 2013
8 Hour Refresher: JAN 2016
8 Hour Supervisor: NOV 2014
CPR: APR 2015
First Aid: APR 2015

MILITARY EOD EXPERIENCE:

NOV 79 – OCT 84	Canadian Forces Bases Chatham, Canada, 416 TAC (F) SQN, EOD Technician
NOV 84 – AUG 90	Canadian Armed Forces Cold Lake, Canada, Wing 4, AETE, EOD Technician
SEP 90 – JUN 91	Canadian Armed Forces Cold Lake, Canada, Wing 4, 419 TAC(F) SQN, EOD Supervisor
JUL 91 – JUN 96	Canadian Armed Forces Cold Lake, Canada, Wing 4, EOD Center #19 NCO I/C

Total Military EOD Experience: 16 years 8 months

CIVILIAN UXO EXPERIENCE:

OCT 96 – DEC 98	UXO Tech II, Human Factors Applications, Inc., Aberdeen Proving Ground, Maryland, Removal Action
JAN 99 – SEP 99	UXO Tech III, Human Factors Applications, Inc., Aberdeen Proving Ground, Maryland, Removal Action
OCT 99 – JUL 00	UXOSO, Human Factors Applications, Aberdeen Proving Ground, Maryland, Removal Action
AUG 00 – MAR 03	SUXOS, Human Factors Applications, Aberdeen Proving Ground, Maryland, Construction Support
APR 03 – OCT 13	UXOSO, General Physics, Aberdeen Proving Ground, Maryland, Construction Support
NOV 13 – DEC 13	UXO Tech II, EA Engineering, Science, and Technology, Inc., Aberdeen Proving Ground, Maryland, Construction Support

JAN 14 – APR 14	UXO Tech III, EA Engineering, Science, and Technology, Inc., Langley Air Force Base, Virginia, Remedial Investigation
MAY 14 – MAR 15	UXO Tech III, EA Engineering, Science, and Technology, Inc., Aberdeen Proving Ground, Maryland, Construction Support Air Force Base, Virginia, Remedial Investigation
MAY 15 – DEC 15	Site Supervisor/SUXOS, EA Engineering, Science, and Technology, Inc., Combat Readiness Training Center Volk Field, Wisconsin, Interim Removal Action and Remedial Investigation
JAN 16 – MAY 16	UXO Tech III, EA Engineering, Science, and Technology, Inc., Aberdeen Proving Ground, Maryland, Construction Support
JUN 16 – JUL 16	SUXOS, EA Engineering, Science, and Technology, Inc., Joint Base Cape Cod, Massachusetts, Remedial Investigation
JUL 16 –AUG 16	SUXOS, EA Engineering, Science, and Technology, Inc., Former York Naval Ordnance Plant (Formerly Used Defense Site), York, Pennsylvania, Remedial Investigation
AUG 16 – SEP 16	UXOQCS/SO, EA Engineering, Science, and Technology, Inc., Base Realignment and Closure Range 17 Soil Remediation at Patuxent research Refuge, Fort George G. Meade, Maryland, Removal Action
SEP 16 – NOV 16	SUXOS, EA Engineering, Science, and Technology, Inc., Former Mortar Impact Area, U.S. Army Garrison Yuma Proving Ground, Arizona, Interim Removal Action

Total Civilian UXO Experience: 20 years

Marlowe Safety and Health Certifications

1.	40-Hour HAZWOPER Original	(No Expiration)	(11/1/1996)
2.	8-HR Supervisor	(No Expiration)	(11/287/2014)
3.	8-HR Refresher for 40hrHAZWOPER	(Annual)	(1/6/2019)
4.	First Aid/CPR	(Biannual)	(3/31/2019)
5.	Bloodborne Pathogen	(Annual)	(11/2/2019)
6.	Medical Surveillance	(Annual)	(1/27/2019)
7.	Certification for Respirator Use	(Annual)	(1/27/2019)
8.	Respirator Fit Test Documentation	(Annual)	(6/12/19)
9.	Basic Explosive Ordnance Disposal	(No Expiration)	(9/30/1995)

Original 40-Hour HAZWOPER

(Does Not Expire)

HFA

CERTIFICATE OF TRAINING

This Certifies That

JOHN D. MARLOWE

Satisfactorily Completed the

OSHA 40 - Hour Hazardous Waste Site Worker and Emergency Response Course

Hazardous Waste Operations
29 CFR 1910.120(e)(1)&(3)

PRESENTED BY HUMAN FACTORS APPLICATIONS, INC.

Dated this 1st Day of November 19 96

INSTRUCTOR

8-Hour Supervisor Training

(Does Not Expire)

8-Hour HAZWOPER Refresher
(Expires 01/06/2019)

First Aid and Cardiopulmonary Resuscitation (Expires 3/31/2019)

Quality Training: When you want it, where you want it.

ProFirstAid® Basic

a ProTrainings.com company

This card certifies that the individual has successfully completed the National Cognitive Evaluation in accordance with ProTrainings Curriculum and the American Heart Association® guidelines

JOHN DAVID MARLOWE

has completed CPR & First Aid (AED inclusive) Certification

Date Issued: **31 Mar 2017** Renew By: **31 Mar 2019**
Certificate # **149098610421781**

This Certification includes the following objectives and is consistent with national consensus 2015 ECC/ILCOR and American Heart Association® Guidelines.

- Adult CPR
- AED
- Bleeding Control
- Musculoskeletal Injuries
- Poisoning
- Shock Management
- Breathing Emergencies
- Heart Attack
- Choking, Conscious and Unconscious
- Universal Precautions
- Diabetic Emergencies
- Stroke
- Burns
- Bites and Stings
- Allergic Reactions
- Seizures
- Heat and Cold Emergencies

Instructor: ROY W. SHAW

888-406-7487 basic.profirstaid.com support@protrainings.com

Dear John David,

Above you will find your ProFirstAid Basic certification card. You may also access this page at a later time by logging into basic.profirstaid.com and clicking the Print Certificate button.

You will also receive a permanent copy of your card in the mail 5-7 business days after the date of purchase.

Below is the mailing address to which we will mail your card.
If there are any problems with any part of this card or address please let us know

ProTrainings Customer Solutions Mon - Fri, 9am - 8pm EST
Phone: 888-406-7487
Email: support@protrainings.com

JOHN DAVID MARLOWE
2115 CALVARY RD
BEL AIR, MD 21015-6414
US

Bloodborne Pathogen
(Expires 11/2/2019)

EA Engineering, Science, and Technology, Inc.

Certificate of Training

PRESENTED TO

John Marlow

FOR COMPLETION OF

Blood-Borne Pathogen Training
IAW 29 CFR 1910.130

02 November 2018

Peter Garger, CIH, CSP

Medical Surveillance (Expires 01/27/2019)

ALLONE HEALTH

Medical Release for Medical Surveillance

Employee's Name:	Marlowe, John
Employee Number:	64023
Birth Date:	10/7/1956 12:00:00 AM
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	1/12/2018 12:00:00 AM
Exam Location:	Concentra Medical Center - Rosedale
	Baltimore, MD
Medical Surveillance:	Medical Surveillance Exam - Annual

I have reviewed the services performed on the above named individual per OSHA regulations and in my opinion,

I have not detected any medical condition which would place the employee at increased risk of health impairment from work.

DOT Result: DOT Card Granted / Renewed: Yes ;Limited Card: Yes ;New card expires: 04/12/2018

Other Comment:

I have informed the employee of the results of the examination and any medical conditions which require further examination or treatment.

For asbestos examinations: The above employee has been informed of the health risks associated with smoking and asbestos exposure.

Authorized Physician	Authorized signature	Date
Dr. Fred Kohanna MD	Fred Kohanna, MD	1/27/2018 2:28:23 PM

CVID: 2105575 Med ResultID: 58952043

Certification for Respirator Use (Expires 01/09/2019)

ALLONE HEALTH

Certification for Respirator Use
29 CFR 1910.134

Employee's Name:	Marlowe, John
Employee Number:	64023
Birth Date:	10/07/1956
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	01/12/2018
Exam Location:	Concentra Medical Center - Rosedale
	Baltimore, MD

I have reviewed the examination of the above named individual and I certify that this employee is physically capable of using all types of respiratory protection.

Other:
CERTIFICATION FOR RESPIRATOR USE EXPIRES 1/12/2019

Prescription eyeglasses and beards cannot be worn with all types of respirators. Any interference with a mask seal is not acceptable. Contact lenses should not be worn while working with acrylonitrile, 1, 2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, and 4,4' - methylene dianiline.

Dr Fred Kohanna	Fred Kohanna, MD	1/27/2018 2:28:59 PM
Authorized signature	Authorized signature	Date

The above employee has been notified of this determination

CVID: 2105575 Medical ResultID: 58952053

Respirator Fit Test Documentation (Expires 6/12/2019)

TOTAL URGENT CARE
Medicine the way it should be...friendly and affordable!!!

2120 Emmorton Park Road, Suite E
Edgewood, MD 21040
Tel: (410) 612-0374 Fax: (410) 612-9174

Respirator Fit Test & Assignment Form
(Qualitative)

Date: 06/12/18 **Employee Name:** John Marlowe **SSN (last 4):** 7127

DOB: 10/07/56 **Employer:** EA Engineering **Job:** __________

Glasses Worn: ☐ Yes ☒ No

Facial Hair Present: ☐ Yes ☒ No **Facial Hair Location:** __________ **Test Performed:** ☒ Yes ☐ No

Note: Fit testing cannot be performed if facial hair is present across respirator seal areas (OSHA REG 29 CFR 1910.134)

The test subject did not eat or drink (except plain water), smoke, or chew gum for 15 minutes prior to the test: ☐ Yes ☒ No

Tested with: Bitrex **Screen Test:** ☒ ten sprays ☐ twenty sprays ☐ thirty sprays ☐ Failed

Respirator Type: Full Face **Size:** Medium	Qualitative Test	Repeated Qualitative
Test Exercise: **D** - detected, **ND** - not detected)		
1. Head stationary, normal breathing (1 minute)	ND	
2. Head stationary, deep breathing & slow breathing (1 minute)	ND	
3. Head turning side to side (1 minute)	ND	
4. Head moving up & down. Inhale in the upward position (1 minute)	ND	
5. Talking slowly & loudly (1 minute) i.e. Rainbow Passage	ND	
6. Bend over as to touch toes	ND	
7. Normal breathing (1 minute)	ND	
8. ***Results:*** **P** - pass **F** - fail	Passed	
Comfort: ☐ Very comfortable ☒ Comfortable ☐ Barely comfortable ☐ Uncomfortable ☐ Intolerable		

Comments: __________

Assigned Equipment/Manufacturer/Model: Millennium MSA 5073

Tested By: Wesley Blackwood

Basic Explosive Ordnance Disposal

(Does Not Expire)

Naval School

Explosive Ordnance Disposal

Certificate of Completion

Presented to

K14-635-678 Sgt. Marlowe, J.D.

For having successfully completed the prescribed course of study for
INTERNATIONAL EXPLOSIVE ORDNANCE DISPOSAL
PHASE II (SURFACE) A - 431 - 0020
on this, the Thirteenth day of October 1995.

EXPLOSIVE ★ ORDNANCE ★ DISPOSAL

USA ★ USMC ★ USN ★ USAF

CDR J.K. Lake, USN
Commanding Officer

John T. Monk

UXO Safety Officer (UXOSO)

Mr. Monk is a Senior Unexploded Ordnance Supervisor (SUXOS) with more than 27 years of experience in Explosive Ordnance Disposal (EOD) Munitions and Explosives of Concern (MEC) and construction projects including acting as Safety and Health Officer (SSHO) and UXO Safety Officer (UXOSO). His project work focuses primarily on safety during the location, removal/disposal, and clearance of conventional, biological, radiological, and chemical warfare munitions (CWM) munitions. Mr. Monk is trained and experienced in performing air monitoring, implementing emergency procedures, and in selecting and wearing PPE. Mr. Monk has operated as a site safety officer, for MEC-related and non-MEC-related projects for over 72 non-overlapping months. Dates prior to 2009 were not required to meet or exceed the standard 60 month requirement.

Qualifications

Education

Naval Explosive Ordnance Disposal School Indian Head, MD

Registrations/Certifications

USACE UXO Specialist (No. 0737)

Specialized Training

OSHA 30-Hour Construction Safety Course; 2005
40-Hour OSHA Hazardous Waste Operations Safety Training Course; 1998
OSHA Hazardous Waste Supervisor's Training Course
OSHA 8-Hour Site Managers and Supervisors Training Course; 2001
OSHA 8-Hour HAZWOPPER Refresher; June 2013
OSHA physical-July 2013
USACE Construction Quality Management for Contractors Course; 2010
Department of Natural Resources and Environmental Control Soil and Water Conservation (Blue Card) Course; 2005
Competent Person Trenching & Excavation, West Virginia University; 2002
Fall Prevention & Protection Competent Person Training; 2002
Dangerous Goods Shipping Procedures; 2002
First Aid and CPR; 2012
Master EOD Technician; 1996
Range Safety Supervisor
Hazardous Waste Management and Shipping for Environmental Professionals; 2001

Professional Experience

SSHO/Senior UXO/MEC Supervisor/Technical Specialist (1987-Present)—Coordinate with range personnel at installations with regard to safety related and munitions use on ranges both past and present. Experience with construction activities and associated safety and health concerns, investigation of sites for safety and health hazards, ensuring proper selection and use of PPE, use of monitoring equipment, and safety and health compliance. Provide health and safety briefings for personnel on site visits. Provide technical review of remedial design projects including safety procedures. Writes site safety and health plans (SSHP).

EA Project Experience

Aberdeen Proving Grounds Aberdeen Area, and Other Edgewood Areas, Maryland, MEC/UXO Construction Support, Department of Public Works Aberdeen Proving Ground; Ongoing, January 2010 –Present [22 Months over a total period of 48 months]; Site Safety and Health Officer (SSHO) and UXO Safety Officer (UXOSO)—Safety Officer for construction support projects on the Aberdeen and Edgewood Areas overseeing various personnel including subcontractors involved in replacing/repairing utilities, trenching and excavation operations, operating heavy equipment, directional drilling, installing wells, soil remediation, wetlands delineation and constructing new buildings. Provided site-specific awareness training to all onsite personnel, including associated subcontractors and new (additional) onsite personnel, prior to the initiation of all activities. Mr. Monk fulfills this role when not on other assignments therefore the total number of months in that role is fewer than the total number of months (48 from January 2010 to present).

Arnold Air Force Base, Military Munitions Response Program, Remedial Investigation, Tennessee; U.S. Army Corps of Engineers (USACE)–Omaha District; February- May 2013 [4 months]; UXO Quality Control Specialist (UXOQCS) and Site Safety and Health Officer (4 Months)—UXOQCS responsible for insuring all activities were performed by Team personnel as outlined in the Work Plan (WP), Accident Prevention Plan (APP), Site Safety and Health Plan (SSHP) and the Quality Assurance Performance Plan (QAPP). Performed Quality Control procedures on all completed grids by the UXO Team. Inventory and inspection of explosives storage magazines on a weekly bases and observed all demolition activities for disposal of live UXO items. Observe Team personnel perform equipment checks daily. Performed MPPEH procedures on munitions debris, certified as Material Documented as Safe (MDAS) to ship, containerized and shipment to scrap metal facility.

Naval Base Magazine, Guam, Environet-Clear, Tree Planting, Santa Rita, Guam; Environet, Inc.; October-November 2012 [0 non-overlapping months]; Senior UXO Supervisor (SUXOS)— SUXOS responsible for insuring all activities were performed by Team personnel as outlined in the Work Plan (WP), Accident Prevention Plan (APP), Site Safety and Health Plan (SSHP) and the Standard Operating Procedures (SOP). Closely monitored and observed the UXO Team during surface clearance of grids for WWII UXO/MEC items. Closely monitored and observed eleven local contractor personnel perform brush clearing of underbrush for all seven acres of the site. Performed MPPEH procedures on munitions debris and certified for turnover to the Naval Guam EOD detachment and larger items shipped to an off island metal recycling contractor for disposal. Coordinated with the EOD Detachment for disposal of five UXO/MEC items found during all activities.

Alpena Combat Readiness Training Center (CRTC), Military Munitions Response Program, Remedial Investigation, Alpena, Michigan; U.S. Army Corps of Engineers (USACE)–Omaha District; September-October 2012 [0 non-overlapping months]; Senior UXO Supervisor (SUXOS)—SUXOS, ***s***upervised six personnel in MEC remedial investigation operations for the inactive 20mm burn pan areas and sampling activities for water/ soil in the area of the inactive burn pan. Closely monitored/observed the UXO Team and the brush clearing crew while they investigate anomalies in the lanes the brush crew cleared of underbrush and small trees, for the remedial investigation. Assisted in the preparation for the quality inspection by quality assurance/quality control personnel and recorded on daily reports. Ensured all safety procedures were covered during the safety meetings each morning provided by the UXO Safety Officer.

Moody Air Force Base (AFB) Remedial Investigation/Feasibility Study (RI/FS), Valdosta, Georgia; U.S. Army Corps of Engineers (USACE)–Omaha District; July-November 2012 [4 non-overlapping months]; Senior UXO Supervisor (SUXOS)— Supervised five personnel in MEC remedial investigation operations for the inactive 40mm range and sampling activities for water/sediment/soil on the inactive skeet range. Closely monitored and observed the UXO Team in the performance of Mag/Flag and Mag/Dig activities. Assisted in the preparation for the quality inspection by quality assurance/quality control personnel and recorded on daily reports. Ensured all safety procedures were covered during the safety meetings each morning provided by the UXO Safety Officer.

Milford and Sussex Ordnance Company, Milford and Sussex, Delaware, MEC Avoidance activities; DNREC; May & August 2012 [2 non-overlapping months]; Senior UXO Technical Specialist—UXO Safety Officer (UXOSO) for avoidance activities during site walk, direct push water, surface soil sampling activities and recon. Performed morning tailgate safety meetings for the site walk; direct push operations; and water/soil sampling activities. Accompanied 3 personnel during initial site walk activities. Supervised 5 personnel during all activities to ensure all MEC safety procedures were enforced and followed during reconnaissance of old explosives manufacturing buildings and at 8 locations for direct push water and surface soil sampling activities.

Remedial Investigation Offutt AFB, NE; USACE—Omaha District; January 2011 –April 2012 [16 non-overlapping months]: UXO Safety Officer/Quality Control Specialist— Responsible for establishing and ensuring compliance with MEC operational risks, as well as all other site specific hazards and safety requirements including: Chemical Warfare Material (CWM) hazards including enforcement of personnel limits, exclusion zones, emergency personnel decontamination station (EPDS) procedures and setup; explosives exclusion zones, explosives transportation, storage and destruction. Conduct daily safety briefings and safety inspections to ensure compliance with MEC and explosives safety codes; and operate and maintain air Monitoring equipment required at the site for possible CWM. Provide Health and Safety training on heavy equipment operation and trenching activities prior to conducting to conducting operation and trenching activities, Ensure proper equipment checks were performed on heavy equipment prior to daily operations..

Military Munitions Response Program Remedial Investigation of Aberdeen Proving Ground; 2010 –2011 [0 non-overlapping months]; UXOSO and SSHO— Responsible for establishing and ensuring compliance with UXO and explosives operational risks, as well as all other site specific hazards and safety requirements including: enforcement of personnel limits and safety exclusion zones, explosives transportation, storage, and destruction. Conducted daily safety briefings and safety inspections to ensure compliance with UXO and explosives safety codes; and operated and maintained air monitoring equipment required at site for airborne contaminates. Provided Health and Safety training on Heavy Equipment operation and trenching activities prior to conducting equipment operation and trenching activities. Ensured proper equipment checks were performed on heavy equipment prior to daily operations.

Aberdeen Proving Grounds Aberdeen Area, and Other Edgewood Areas, Maryland, MEC/UXO Construction Support, Department of Public Works Aberdeen Proving Ground; January 2009 – December 2010 [24 non-overlapping months]; Safety Officer—Safety Officer for construction support projects on the Aberdeen and Edgewood Areas overseeing various personnel involved in replacing/repairing utilities, operating heavy equipment, installing wells and constructing new buildings. Provided site-specific awareness training to all onsite personnel, including associated subcontractors and new (additional) onsite personnel, prior to the initiation of all activities.

Operational Range Assessment Program; USACE; 2006 – Present; Safety Officer—Implemented and enforces programmatic safety procedures, including providing MEC awareness training, performing tailgate safety briefings, and investigating and reporting accidents and near misses. Roles for this work were as-needed at over 10 different installations and during every sampling season.

Munitions and Explosives of Concern Support at Governor Harry W. Nice Memorial Bridge Improvement Project; 2009; Safety Officer —Prepared and enforced the Accident Prevention Plan for activities occurring on-site including equipment inspection, subsurface boring and trenching. Duties also entailed presenting daily tailgate briefings and performing safety reporting.

Non-Department of Defense, Non-Operational Defense Site Inventory, Western U.S. Region Army National Guard; 2007 – 2009; UXO Safety Officer—Implemented programmatic safety and health plans; reviewed and inspected for compliance of SSHP, provided safety oversight during field operations.

St. Georges Bridge, St. Georges, Delaware; USACE–Philadelphia District, Delaware Department of Natural Resources and Environmental Control; 2007; Safety Officer—Responsible for developing and implementing health and safety procedures for all personnel onsite. Supervised field activities including operation of heavy equipment during excavation of remediation pits, maintenance of the site entry and exit log and implementation of PPE usage.

U.S. Air Force, Eielson Air Force Base, Alaska, MEC Geophysical Screening and Anomaly Removal at the Garrison Slough; 2007; Safety Officer — Responsible for developing and implementing health and safety procedures during removal of 600 MEC anomalies below the waterline. Duties included presenting onsite health and safety meetings, compliance with Site Safety and Health Plan, ensuring the proper calibration and use of monitoring equipment and monitoring proper use of personal protective equipment (PPE).

Remedial Investigation/Feasibility Study Wake Island; Air Force Center for Environmental Excellence, Hickam Air Force Base, Hawaii; 2006; Senior UXO/MEC Supervisor/Technical Specialist— Performed daily health, safety and operations briefings, provided safety oversight during boat operations, drilling and monitoring well installation, heavy equipment operations and soil, sediment, surface water and groundwater sample collection.

MEC Design Build, Urunao, Guam; Air Force Center for Environmental Excellence, Andersen Air Force Base; 2004 – 2005; Senior UXO/MEC Supervisor/Technical Specialist—Supervised subcontractor personnel while they investigated UXO anomalies. Developed procedures to document MEC activities on-site including daily safety inspections.

Other Project Experience

Spring Valley, D.C. Geophysical Survey, USACE–Baltimore; 2002—UXO Safety Officer- Responsible for implementing the approved explosives and UXO safety program in compliance with all DOD, Federal, state, and local statutes and codes. Analyzed UXO and explosives operational risks, hazards, and safety requirements; enforced personnel limits and safety exclusion zones for UXO clearance operations, explosives transportation, storage, and destruction; conducted safety inspections to ensure compliance with safety codes; and operated and maintain air monitoring equipment required across nine locations ranging in size from 1 to 2 acres.

Monk Safety and Health Certifications

1.	40-Hour HAZWOPER Original	(No Expiration)	(05/22/1998)
2.	8-HR Supervisor	(No Expiration)	(05/27/2015)
3.	30-HR Construction	(No Expiration)	(07/15/2005)
4.	8-HR Refresher for 40hrHAZWOPER	(Annual)	(5/17/2018)
5.	First Aid/CPR	(Biannual)	(1/9/2019)
6.	Bloodborne Pathogens Workplace	(Annual)	()
7.	Medical Surveillance	(Annual)	(05/29/2019)
8.	Certification for Respirator Use	(Annual)	(05/29/2019)
9.	Basic Ordnance Disposal	(No Expiration)	(2/19/1987)

Original 40-Hour HAZWOPER

(Does Not Expire)

HFA

CERTIFICATE OF TRAINING

This Certifies That

JOHN MONK

Satisfactorily Completed the

OSHA 40 Hour - Hazardous Waste Site Worker
And Emergency Response Course

Hazardous Waste Operations
29 CFR 1910.120(e)(1)&(3)

PRESENTED BY HUMAN FACTORS APPLICATIONS, INC.

Dated this 22nd Day of May 1998

Michael L Wainright

INSTRUCTOR

8-Hour Supervisor Training

(Does Not Expire)

Certificate of Completion

This certifies that

John T Monk

Has Successfully completed

8 Hour HAZWOPER Supervisor Refresher Training

This certification alone does NOT indicate INITIAL 8 Hour OSHA Supervisor Training

In Accordance With Federal OSHA Regulation 29 CFR 1910.120(e)(8)

And all State OSHA/EPA Regulations as well

This course is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) issued by Safety Unlimited, Inc. (Accreditation # 044)

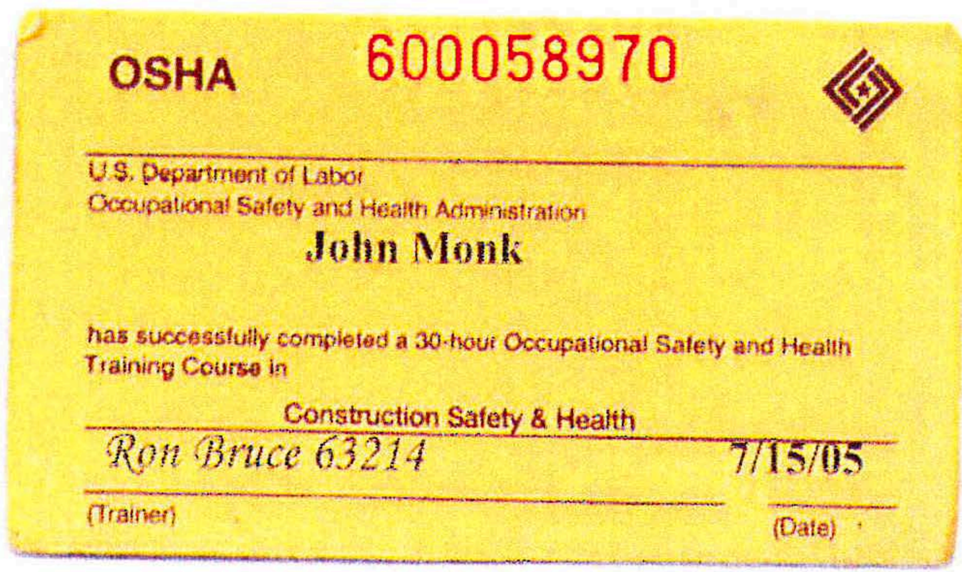
Julius P. Griggs	1505275141193	5/27/2015
Julius P. Griggs Instructor #892	Certificate Number	Issue Date

SAFETY UNLIMITED, Inc.
OSHA Compliant Safety Training Since 1993

2139 Tapo St., Suite 228 Simi Valley, CA 93063
888 309-SAFE (7233) or 805 306-8027 866-869-7097 (fax)
www.safetyunlimited.com

Proof of initial certification and subsequent refresher training is NOT required to take refresher training
Want to be sure this certificate is valid? Visit safetyunlimited.com/verification

30-Hour Construction
(Does Not Expire)



8-Hour HAZWOPER Refresher
(Expires 03/23/2019)

Certificate of Completion

This certifies that

John T. Monk

has successfully completed

8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)

And all State OSHA/EPA Regulations as well including 29 CFR 1926.65 for Construction.

This course (Version 3) is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) (Accreditation # 044).

Julius P. Griggs
Julius P. Griggs
Instructor #892

1805175238768
Certificate Number

5/17/2018
Issue Date

SAFETY UNLIMITED, Inc.
OSHA Compliant Safety Training Since 1993

Scan this code or visit www.safetyunlimited.com/v to verify certificate.

Proof of initial certification and subsequent refresher training is NOT required to take refresher training

2139 Tapo St., Suite 228 Simi Valley,CA 93063
(888) 309-SAFE (7233) or 805 306-8027
https://www.safetyunlimited.com

First Aid and Cardiopulmonary Resuscitation (Expires 12/08/2019)

American Red Cross

John Monk

has successfully completed requirements for

Adult First Aid/CPR/AED: valid 2 Years

Date Completed: 01/09/2017

conducted by: American Red Cross

Instructor: Ann Evans

ID: 0ZESVA

Scan code or visit:

redcross.org/confirm

Medical Surveillance
(Expires 05/29/2019)

ALLONE HEALTH

Medical Release for Medical Surveillance

Employee's Name:	Monk, John
Employee Number:	66687
Birth Date:	2/27/1959 12:00:00 AM
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	5/18/2018 12:00:00 AM
Exam Location:	Concentra Medical Center - York
	York, PA
Medical Surveillance:	Medical Surveillance Exam - Annual

I have reviewed the services performed on the above named individual per OSHA regulations and in my opinion,

I have not detected any medical condition which would place the employee at increased risk of health impairment from work.

Other Comment:

I have informed the employee of the results of the examination and any medical conditions which require further examination or treatment.

For asbestos examinations: The above employee has been informed of the health risks associated with smoking and asbestos exposure.

Dr Fred Kohanna	Fred Kohanna, MD	5/29/2018 10:00:32 AM
Authorized Physician	Authorized signature	Date

CVID: 2297703

Med ResultID: 61274203

Certification for Respirator Use (Expires 01/09/2019)

Certification for Respirator Use
29 CFR 1910.134

Employee's Name:	Monk, John
Employee Number:	66687
Birth Date:	02/27/1959
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	05/18/2018
Exam Location:	Concentra Medical Center - York
	York, PA

I have reviewed the examination of the above named individual and I certify that this employee is physically capable of using all types of respiratory protection.

Other:
CERTIFICATION FOR RESPIRATOR USE EXPIRES 5/18/2019

Prescription eyeglasses and beards cannot be worn with all types of respirators. Any interference with a mask seal is not acceptable. Contact lenses should not be worn while working with acrylonitrile, 1, 2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, and 4,4' - methylene dianiline.

Dr Fred Kohanna	Fred Kohanna, MD	5/29/2018 10:07:13 AM
Authorized signature	Authorized signature	Date

The above employee has been notified of this determination

CVID: 2297703 Medical ResultID: 61274213

WARD R. STERN
PHONE: (256) 731-9151
EMAIL: wrstern@tecoptic.com

OVERVIEW:

For over thirty years I have planned and accomplished safe execution of work, which consisted of heavy equipment operation, construction, construction safety, quality control, quality assurance, explosives operations, explosive safety, environmental investigations and remediation projects, demining, physical security, C-IED intelligence gathering, EOD instruction and curriculum development.

During this time, I have focused all professional energies on studying and practicing the various facets of the science and art of Explosive Ordnance Disposal (EOD)/ Unexploded Ordnance (UXO). Each project has brought opportunities to employ possessed knowledge, skills and abilities, as well as to acquire new experiences that continue to build my effectiveness in executing the required standard.

Periodically, I provide, gratis, UXO industry related articles and information to the on-line source, UXOInfo.com, as well provide training images to the US Army EOD Training Department, Ft Lee, VA to promote the betterment of the tradecraft/ industry.

NAVAL BASIC EOD SCHOOL: APR - SEP 1981 **OSHA ANNUAL HAZWOPER PHYSICAL DATE:** FEB 2018

OTHER PERTINENT TRAINING: USACE CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS 2016; FIRST AID/ CPR 2016; HAZWOPER 8 HOUR REFRESHER 2018; PRACTICAL LOSS CONTROL LEADERSHIP, DET NORSKE VERITAS 2008; CONSTRUCTION 30 HOUR 2007; OSHA HAZARDOUS WASTE SITE SUPERVISOR TRAINING 2007; CULTURAL RESOURCE MANAGEMENT COMPLIANCE FOR NON-SPECIALISTS 2003; HAZWOPER 40 HOUR 1995; US ARMY AMMUNITION QUALITY ASSURANCE INSPECTOR 1985; US ARMY EXPLOSIVE SAFETY COURSE 1985

USACE # 0349

MILITARY EOD/ CONTRACTOR EOD RELATED POSITIONS:

JUL 12 - JUL 13	Explosives (HME) Instructor, US BATFE Contractor, BATFE HME Course, Redstone Arsenal, AL
MAR 11 - JUN 11	EOD Demolition Instructor, US Army Contractor, Redstone Arsenal, AL
JUL 08 – AUG 10	EOD Fuzing and Demolition Instructor, US Army Contractor, Redstone Arsenal, AL/ EOD Training Developer, US Army Contractor, Ft Lee, VA
MAY 88 - NOV 90	Senior Ammunition Quality Assurance (QA) Inspector, 10th Trans. Bn., Ft. Eustis, VA
MAY 85 - MAY 88	Ammunition QA Inspector, 23rd Ord. Co., Kriegsfeld, Germany
AUG 81 - MAR 85	EOD Technician, 56th EOD, Ft. Indiantown Gap, PA

CIVILIAN UXO EXPERIENCE:

AUG 18 – PRESENT	SUXOS, MMG, Beltway 9963 Project, Orlando, FL – RA: Manage Two UXO Teams, Vegetation Removal, Non-Munition Related Debris (NMRD) Metals Reclamation
APR 18 – JUL 18	UXOSO, MMG, USACE, Arnold AFB, TN – Analog/ DGM RI: Magnetometer Assisted Surface Clearance, subsurface Digital Geophysical Mapping (DGM), target selection, reacquisition and intrusive investigations, Buried Explosive Module (BEM)
NOV 17 – MAR 18	UXOQCS, Bristol Environmental Services, USACE, University of Nevada, Las Vegas, NV – DGM/ Analog RI: MDAS Demilitarization/ Certification, Blind Seeding Program (BSP)
NOV 17 – NOV 17	UXO Tech III, EA Engineering, USACE, Edgewood Arsenal, MD – Analog, Construction Support
OCT 17 – NOV 17	UXOQCS/ UXOSO, AEROTEK, USACE, Ft Polk, LA – Analog RA: MDAS Certification, BSP
JUN 17 – SEP 17	UXOQCS/ UXOSO, EA Engineering, USACE, JBCC, MA – Analog RI: MDAS Certification, BSP
MAR 17 – JUN 17	UXOQCS, EA Engineering, USACE, Camp Claiborne, LA – Analog RA: MDAS Certification, BSP
JAN 17 – MAR 17	UXOQCS/ UXOSO, AECOM, NAVSEA, UXO Outfall Ditch Area, NAS Kingsville, TX – DGM RI and Analog RA: MDAS Certification, BSP, BEM
OCT 16 – NOV 16 Cert., BEM	SUXOS, BAY WEST LLC, Volk Field, WI – RI: Two Teams Excavation reacquired targets, MDAS
OCT 16 – OCT 16	UXOQCS/ UXOSO, AECOM, The former Shumaker Naval Ammunition Depot (NAD), Camden AR – Construction Support, MDAS Certification, Thermal Treatment Plant
SEP 16 – SEP 16	UXOQCS/ UXOSO, AECOM, NAVSEA, Fleming Key Dredge Spoils Area, NAS Key West, FL – RI: Excavation reacquired targets, MDAS Certification.
AUG 16 – AUG 16	UXOQCS/UXOSO, EA Engineering, Science and Technology, AFCEE, Hill AFB, UT – RA: Excavation reacquired targets, Heavy Equipment and Power Screen Sifting of former burn pads, Lead Abatement, MDAS Certification, and Demolition Operations.
JUN 16 – JUL 16	UXOQCS/ UXOSO, EA Engineering, AFCEE, Joint Base CC, MA – Pre-RI and Former York Naval Ordnance Plant, York, PA – RI: Excavation reacquired targets, MDAS Certification, X-Ray identification of HEAT MEC 2.36" Rockets, BEM.
APR 16 – MAY 16	Technician III, EOTI Munitions and Env. Svcs, Chaffee, AR – RA: Clearance, MD Sorting.
NOV 15 – DEC 15	SUXOS, ERT, Inc., Ft Hancock, NJ – RI: Two Teams, Selected Target Investigation, Livens Projectiles.
MAY 15 – NOV 15	UXOQCS/UXOSO, AEROTEK, Volk Field, WI – RI: TRANSECTS and RA
NOV 14 - APR 15	UXOQCS, AECOM, Ft McClellan, AL – RI: TRANSECTS
JUL 13 - SEP 14	UXOQCS, Kemron Env Svcs, Ft McClellan, AL – RA, and Tooele AD-South, UT - RA

WARD R. STERN
PHONE: (256) 731-9151
EMAIL: wrstern@tecoptic.com

CIVILIAN UXO EXPERIENCE (continued):

SEP 10 – DEC 10	SUXOS, DynCorp Intl, Fairfax, VA/ US State Dept., Afghanistan – RA: One Team LN, Battle Area Clearance (BAC)
MAR 06 – JUL 08	UXOQC/UXOSO, TetraTech ECI, Bothell, WA and USACE CMCP, Iraq – RA: BAC
JUL 04 - MAR 06	UXOQC/UXOSO, AMEC E&E, Ft A.P Hill, VA – RA/ Hurlburt Field, FL, Ft McCoy, WI – RI
JAN 01 - JUL 04	UXOQC/UXOSO, AMEC E& E, Massachusetts Military Reservation, MA - RI
NOV 00 - DEC 00	Technician III, Plexus Scientific, Columbia, Kansas Army Ammunition Plant, KS – RI: Perchlorate Sump Sampling
OCT 00 - NOV 00	Technician II/ Equipment Operator, Omegasys Env Svcs, Redstone Arsenal, AL - RA
JUN 00 - SEP 00	Technician II, Sudhakar Company Inc., Redstone Arsenal, AL - RA
MAR 99 - JUN 00	UXOQC/UXOSO, Plexus Scientific JAAP, IL - RA LCAAP, KS – RI
SEP 98 - MAR 99	Technician II, ECC, Mare Island Straight, CA - RI
JUN 98 - SEP 98	Technician II, Plexus Scientific, Indiana and Longhorn AA Plant, IN and TX - RI
MAR 98 - JUN 98	Technician II, EOD-T, Panama Canal Zone, Panama - RI
NOV 97 - MAR 98	Technician II/ Heavy Equipment, Ft. Rucker, AL – RA: Construction Support
OCT 97 - NOV 97	Technician III, ETSC Government Services, Wright-Patterson AF Base, OH - RA
AUG 97 - OCT 97	Technician III, OrdSafe Ltd., Texaco Oil, Kwanda Base, Soyo, Angola - RA
JUN 97 - AUG 97	Technician II, HFA, Dolly Sods Wilderness Area, WV - RA
APR 97 - JUN 97	Technician II, EHSI, Berkley, CO - RA
APR 96 - APR 97	Technician II, ETSC Government Services, Joliet Army Ammunition Plant, IL – RI and RA
FEB 96 - APR 96	Technician III/ Heavy Equipment Operator, IT Corp., Williams AFB, AZ – RA
SEP 95 - NOV 95	Technician II, ATG, Leach Lake, CA – RA: (RANGE MAINTENANCE)
MAR 95 - SEP 95	Technician II, ECC, San Diego, CA - RA
FEB 93 - AUG 93	Technician III, CMS Environmental Inc., Demining, Kuwait – RA: BAC
FEB 92 - FEB 93	Technician II, EOD World Services Inc., Kuwait – RA: BAC
JUN 91 - FEB 92	Technician II UXB Intl, Fallon, NV – Range Maintenance, and Dolly Sods, WV – RI

ARTICLES WRITTEN:

“Lessons Learned in Expedient Improvised Protective Works” May 2012, Ward R. Stern, UXOInfo.com

“Using the Portable X-ray to Acquire Positive Identification” October 2010, Ward Stern, UXOInfo.com

DUTIES AND WORK EXPERIENCE SUMMARY:

Possess experience in heavy equipment operations, construction, construction safety, geophysics collection, ordnance identification, quality control, quality assurance, physical security, explosives operations, explosive safety, MDAS (certification, chain of custody, labeling, shipping), Blind Seeding Program (BSP), training and demining. Performed technical safety reviews, developed and prepared required Quality Control (QC) documentation for Government (client) acceptance. Performed QC inspections on work performed. Reviewed and/or provided input to contract documents, such as Statements of Work and Specifications, for safety/ quality-related implications to ensure considerations were properly addressed. Prepared, updated, or assisted in the development of Safety Assessment Reports, Hazard Analyses, and Safety Risk Assessments. Participated/supported System Safety Working Groups (SSWG). Prepared, reviewed, or provided input to Safety Management Plans (SMPs) and Site Safety Program Plans (SSPPs) and related program management safety and quality documentation. Prepared and maintained Hazard Tracking functions for project office. Conducted and reviewed safety and quality assessments.

MANAGEMENT SKILLS SUMMARY:

EXPLOSIVE SAFETY, QUALITY ASSURANCE, CONSTRUCTION SAFETY/QC OPERATIONS AND MANAGEMENT: Performed safety management/ QA and QC oversight functions on various Facilities Demolition, Property Disposal Classification Projects, Metals Reclamation Operations, Range Maintenance Activities, UXO Disposal Operations, Demolitions Training, Environmental Studies, Remedial Investigations (RI), and Removal Actions (RA).

COMPUTER SKILLS: Proficient with Microsoft Office (Word, Excel, PowerPoint), Adobe Acrobat Professional, and Photoshop.

PERSONNEL MANAGEMENT/ TEAM BUILDING SKILLS: Possess sound management background, sound judgment, outstanding problem solving, and excellent communication skills. Experienced in building and managing sustainable, goal-oriented programs.

EDUCATION:

Air University (10/14/1986 - 10/14/1987): Maxwell AFB, Alabama, Certificate - Major: Safety Specialist

Stern Safety and Health Certifications

1.	40-Hour HAZWOPER Original	(No Expiration)	(11/1/1996)
2.	8-HR Supervisor	(No Expiration)	(11/287/2014)
3.	8-HR Refresher for 40hrHAZWOPER	(Annual)	(1/6/2019)
4.	First Aid/CPR	(Biannual)	(3/31/2019)
5.	Medical Surveillance	(Annual)	(01/27/2019)
6.	Certification for Respirator Use	(Annual)	(01/27/2019)
7.	Basic Explosive Ordnance Disposal	(No Expiration)	(9/25/1981)

Original 40-Hour HAZWOPER

(Does Not Expire)

HFA

CERTIFICATE OF TRAINING

This Certifies That

JOHN D. MARLOWE

Satisfactorily Completed the

OSHA 40 - Hour Hazardous Waste Site Worker
and Emergency Response Course

Hazardous Waste Operations
29 CFR 1910.120(e)(1)&(3)

PRESENTED BY HUMAN FACTORS APPLICATIONS, INC.

Dated this 1st Day of November 19 96

INSTRUCTOR

First Aid and Cardiopulmonary Resuscitation (Expires 3/31/2019)

Quality Training: When you want it, where you want it.

ProFirstAid® Basic

a ProTrainings.com company

This card certifies that the individual has successfully completed the National Cognitive Evaluation in accordance with ProTrainings Curriculum and the American Heart Association® guidelines

JOHN DAVID MARLOWE

has completed CPR & First Aid (AED inclusive) Certification

Date Issued: **31 Mar 2017** Renew By: **31 Mar 2019**
Certificate # **149098610421781**

This Certification includes the following objectives and is consistent with national consensus 2015 ECC/ILCOR and American Heart Association® Guidelines.

- Adult CPR
- AED
- Bleeding Control
- Musculoskeletal Injuries
- Poisoning
- Shock Management
- Breathing Emergencies
- Heart Attack
- Choking, Conscious and Unconscious
- Universal Precautions
- Diabetic Emergencies
- Stroke
- Burns
- Bites and Stings
- Allergic Reactions
- Seizures
- Heat and Cold Emergencies

Instructor: ROY W. SHAW

888-406-7487 basic.profirstaid.com support@protrainings.com

Dear John David,

Above you will find your ProFirstAid Basic certification card. You may also access this page at a later time by logging into basic.profirstaid.com and clicking the Print Certificate button.

You will also receive a permanent copy of your card in the mail 5-7 business days after the date of purchase.

Below is the mailing address to which we will mail your card.
If there are any problems with any part of this card or address please let us know

ProTrainings Customer Solutions Mon - Fri, 9am - 8pm EST
Phone: 888-406-7487
Email: support@protrainings.com

JOHN DAVID MARLOWE
2115 CALVARY RD
BEL AIR, MD 21015-6414
US

Medical Surveillance
(Expires 01/27/2019)

ALLONE HEALTH

Medical Release for Medical Surveillance

Employee's Name:	Marlowe, John
Employee Number:	64023
Birth Date:	10/7/1956 12:00:00 AM
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	1/12/2018 12:00:00 AM
Exam Location:	Concentra Medical Center - Rosedale
	Baltimore, MD
Medical Surveillance:	Medical Surveillance Exam - Annual

I have reviewed the services performed on the above named individual per OSHA regulations and in my opinion,

I have not detected any medical condition which would place the employee at increased risk of health impairment from work.

DOT Result: DOT Card Granted / Renewed: Yes ;Limited Card: Yes ;New card expires: 04/12/2018

Other Comment:

I have informed the employee of the results of the examination and any medical conditions which require further examination or treatment.

For asbestos examinations: The above employee has been informed of the health risks associated with smoking and asbestos exposure.

Dr. Fred Kohanna MD	Fred Kohanna, MD	1/27/2018 2:28:23 PM
Authorized Physician	Authorized signature	Date

CVID: 2105575 Med ResultID: 58952043

Certification for Respirator Use (Expires 01/09/2019)

ALLONE HEALTH

Certification for Respirator Use
29 CFR 1910.134

Employee's Name:	Marlowe, John
Employee Number:	64023
Birth Date:	10/07/1956
Company:	EA Engineering Science & Technology, Inc
Company Location:	Baltimore, MD
Date of Exam:	01/12/2018
Exam Location:	Concentra Medical Center - Rosedale
	Baltimore, MD

I have reviewed the examination of the above named individual and I certify that this employee is physically capable of using all types of respiratory protection.

Other:
CERTIFICATION FOR RESPIRATOR USE EXPIRES 1/12/2019

Prescription eyeglasses and beards cannot be worn with all types of respirators. Any interference with a mask seal is not acceptable. Contact lenses should not be worn while working with acrylonitrile, 1, 2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, and 4,4' - methylene dianiline.

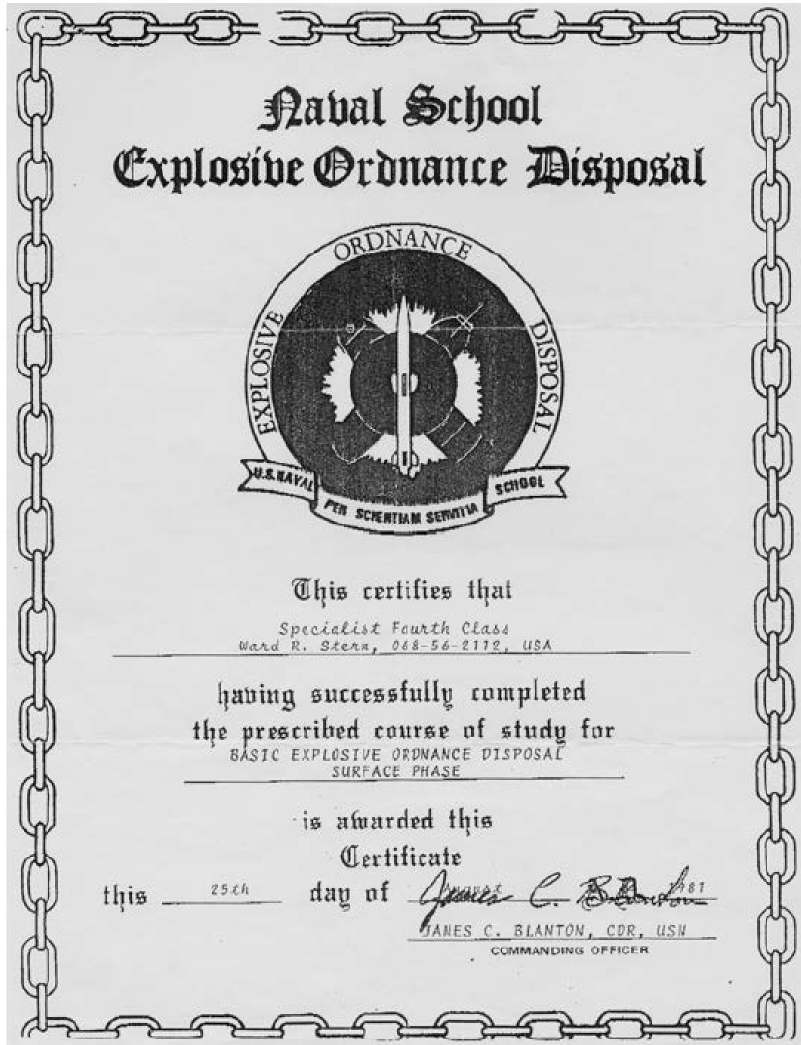
Dr Fred Kohanna	Fred Kohanna, MD	1/27/2018 2:28:59 PM
Authorized signature	Authorized signature	Date

The above employee has been notified of this determination

CVID: 2105575 Medical ResultID: 58952053

Basic Explosive Ordnance Disposal

(Does Not Expire)



Naval School
Explosive Ordnance Disposal

ORDNANCE
EXPLOSIVE DISPOSAL
U.S. NAVAL SCHOOL
PER SCIENTIAM SERVITIA

This certifies that

Specialist Fourth Class
Ward R. Stern, 068-56-2112, USA

having successfully completed
the prescribed course of study for
BASIC EXPLOSIVE ORDNANCE DISPOSAL
SURFACE PHASE

is awarded this
Certificate

this 25th day of August 1981

JAMES C. BLANTON, CDR, USN
COMMANDING OFFICER

Appendix D

Field and Inspection Forms

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SMALL BOAT INSPECTION CHECKLIST
U.S. Army Engineer District, New Orleans

SMALL BOAT INSPECTION CHECKLIST U.S. Army Engineer District, New Orleans	Date of Inspection:		
Contractor or Unit	Contract No. Or Activity		
Inspected by (Signature)	Witness (Signature)		
NOTE: Safety and Health Requirements Manual (EM385-1-1 (15 Sep 08)) references in parentheses.	Yes	No	N/A
1. Are periodic inspections & tests of all marine plant & equipment made to insure safe operating conditions and records retained? (19.A.01(c)(d)).			
2. Are marine plant and/or equipment found to be in unsafe condition, taken out of service and its use prohibited until unsafe conditions are corrected? (19.A.01(e))			
3. Are all items of floating plant or associated equipment stored or placed beyond 20 feet or overhead transmission or distribution lines? (11.E.07)			
4. Has all marine plant & equipment put into use on the job inspected, tested and found to be in safe operating condition before initial use and at least annually thereafter by a qualified person and documentation retained? (19.A.01(a))			
5. Do inspection records maintained at the site become part of the official project file and made available to designated authorities? (19.A.01(d)and (b))			
6. Is the maximum number of passengers that can be safely transported posted on all launches, motorboats and skiffs? (19.F.02(a))			
7. Is a signal device provided on the vessel to give signals required by applicable navigation rules? (19.A.05(c))			
8. Is a fully stocked first aid kit of the proper size on board? (03.B)			
9. Has a Type III/Type V or better USCG personal flotation device (PFD) been provided to all boat passengers and are they properly worn? (Section O5.J)			
10. Are PFD' s inspected for defects, which would alter their buoyancy before and after each use? (05.J.05)			
11. Are defective PFD's or PFD's removed from service? (05.J.02)			
12. Are all PFD's equipped with retro-reflective tape, automatic activating lights and whistles? (05.J.03)			
13. Is each boat equipped with at least one USCG approved life ring or ring buoy with at least 70 feet of solid braid polypropylene line or equal attached? (05.J.03(d))			
14. If adequate lighting is not available (i.e. flood lights/pole lights), are life rings equipped with automatic floating electric water lights (first life ring and at least every third life ring thereafter)? (05.J.03(b))			
15. If the boat or launch is open cabin, is it equipped with a kill switch? (19.F.02(d))			
16. Are all launches and motor boats equipped with fire extinguishers of at least the size and rating(s) specified? (19.F.03; Table 19-1)			
17. Are all carburetors on gasoline engines equipped with backfire trap or flame arrestor? (19.A.06(d))			
18. Are provisions in place to prevent accumulation of fuel and grease on floors and decks and in bilges? (19.A.07(c))			
19. For internal combustion engines with electric spark ignition systems or similar auxiliary engines of this type in cabins, compartments or confined spaces, is the engine equipped with an exhaust fan(s) for ventilating the engine space and bilges? (19.A.10(a)			

NOTE: Safety and Health Requirements Manual (EM385-1-1 (15 Sep 08)) references in parentheses.	Yes	No	N/A
20. Are boats powered by internal combustion engines located within compartments or confined spaces equipped with vent fans rated for Class I locations? (19.A.10(g)(1))			
21. Are vent intakes extended to within one foot of the engine compartment bottom? (19.A.10(g)(2))			
22 **BOAT TRAILERING** (Following is related to LA State Law and National Association of Safe Boating Laws. There is no reference to EM-385-1-1 in most cases.)			
a. Is the hitch secured to the tongue locking mechanism sound and non-binding?			
b. Are safety chains and hooks adequate for the size of the load?			
c. Are all lights (brake, turning and running) operating properly?			
d. Are tires in good condition (adequate tread, free of dry rot) and properly inflated?			
e. Are wheel bearings properly lubricated and is the proper torque on the wheel nut?			
f. Are caps and/or buddy bearings installed properly and functional?			
g. Are brakes (if equipped) working properly?			
h. Is the trailer tongue weight proper for the boat carried?			
I. Are rollers and/or bunks properly aligned and in good condition?			
j. Are trailer wheel bearing seals marine grade & do they seal properly to prevent seepage of water into bearings and races?			
k. Has the trailer's master cylinder been checked for proper level of fluid and are there any signs of brake fluid leakage?			
l. Has the trailer's wheel cylinders been inspected for signs of brake fluid leakage under dry conditions?			
m. Is the trailer suspension system adequate and capable of supporting the boat and other equipment loadings?			
n. Is the boat secured at bow and stern when being trailer?			
o. Has a transom saver been installed for support of outboard motor (foot)?			
p. Are trailer safety chains of a sufficient length to properly cradle the trailer tongue?			
23 **TOWING VEHICLE**			
a. Is the vehicle of adequate weight and power to safely tow the loaded boat and trailer?			
b. Is the hitch properly rated for the weight of the boat and trailer to be towed?			
c. Is the hitch secured to the frame (not bumper) of the vehicle?			
d. Is the ball on the hitch the proper size for the trailer to be towed?			
e. Is the ball securely attached to the tow bar?			
f. Is the remote braking mechanism operating properly			
g. Does the towing vehicle have adequately sized rear-view mirrors on both sides?			
h. Is rear suspension of towing vehicle sufficient & in condition to accept trailer tongue weight?			

TAILGATE SAFETY BRIEFING (D-1)

Date: _____/_____/_____ **Location:**______________________

Time: _____________AM PM **Team #:** ______________________

1. Reason for Briefing:

	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position

Briefing Given By:

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response/Equipment
	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Safe Work Practices		Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Being Performed		Confined Spaces
	OE Precautions		Other:

4. Remarks:

ACCIDENT PREVENTION PLAN REVIEW RECORD

SITE: ______________________________________

EA Project No.______________________________

I have read the Accident Prevention Plan and have been briefed on anticipated site hazards, required accident prevention, and emergency response for work to be performed at this site. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date

ENVIRONMENTAL MONITORING RECORD

SITE: ____

PROJECT NO.: ____

INSTRUMENT: ____

Time	Monitoring Location	Reading	Corrective Action Taken[a]
________	________________________________	__________	____________
________	________________________________	__________	____________
________	________________________________	__________	____________
________	________________________________	__________	____________
________	________________________________	__________	____________
________	________________________________	__________	____________
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________	________________________________	__________	____________
________	________________________________	__________	____________
________	________________________________	__________	____________

Comments: ____

____

____

(a) Corrective actions taken must be documented whenever readings at or above action levels are reached. Monitoring equipment and action levels are specified in Section 9.33 of the Accident Prevention Plan.

Recorded By: ______________________________ Date: ______________

Site Health & Safety Officer

HEALTH AND SAFETY ACTIVITY REPORT

Site: ____ Location:____________________

Weather Cond.: ______________________ Onsite Hours: From _______ To _______

Changes in PPE Levels[1] Work Operations Reasons for Change

Site Safety and Health Plan Violations | Corrective Action Specified | Corrective Action Taken [2](yes/no)

Observations and Comments:

Completed by: ____ Date:
Site Health and Safety Supervisor

[1]Only SSHO may change PPE levels, using only criteria specified in APP/SSHP.
[2]If a deficiency is noted that cannot be immediately corrected, the SSHO will monitor the progress in correcting the deficiency and will document following:

- Date the deficiency was identified
- Description of the deficiency
- Name of the person responsible for correcting the deficiency
- Projected date of correction
- Actual date of correction.

EA Engineering, Science, and Technology, Inc

Employee/Visitor Register and Safety Brief				
Date:				
Site Entry/Exit		**Name (Printed)**	**Signature**	**Company**
Time In	**Time Out**			

HEALTH AND SAFETY EQUIPMENT CALIBRATION LOG

Project Name: ___________________ Project Number:

Date	Time	Initials	Instrument Type and ID (i.e., serial number)	Calibration Gas Type and Concentration	Initial Reading (units)	Adjustments Required and Comments	Final Reading (units)

Signature of SSHO:

QUALITY CONTROL

HEALTH AND SAFETY CHECKLIST

Date:

Project Name/Number:___________________________________

Site:

Personnel Observed and Locations:

Answer each question by checking the appropriate column (yes, no, or N/A). If "no" is checked, provide an explanation on the form.

Documentation	**Yes**	**No**	**N/A**
1. Is the Accident Prevention Plan (APP) and Site Health and Safety Plan (SSHP) on the Site?	☐	☐	☐
2. Has the SSHP and/or supplement been reviewed, dated, and signed within the last year?	☐	☐	☐
3. Are the tasks being completed reflected in the Supplement?	☐	☐	☐
4. Is there a written acknowledgement that all employees have been briefed on and read the SSHP (signature sheet)?	☐	☐	☐
5. Are the following training records current and available:			
• 40-Hour HAZWOPER for ALL employees?	☐	☐	☐
• 24 Hours Supervised Field Experience?	☐	☐	☐
• 8-Hour HAZWOPER Annual Refresher?	☐	☐	☐
• CPR/First Aid (minimum one person on site)?	☐	☐	☐
• 8-Hour Hazardous Waste Site Supervisor, and refresher?	☐	☐	☐
• Initial Site Health and Safety Briefing?	☐	☐	☐
• Site Health and Safety Briefing for each location or site (record in field log notebook)?	☐	☐	☐
6. Are emergency maps posted at the site and maintained in vehicles?	☐	☐	☐
7. Were fire extinguishers checked on first day?	☐	☐	☐
8. Were applicable Material Safety Data Sheets at the Site (located in IT Sampling Plan)?	☐	☐	☐
9. Are documents current and available that indicate personnel are medically fit to work and wear the required personal protective equipment (if required)?	☐	☐	☐

QUALITY CONTROL

HEALTH AND SAFETY CHECKLIST (continued)

Date:

Project Name/Number:

Site:

	Yes	No	N/A
Observations			
10. Are work zones adequately designated?	☐	☐	☐
11. Is required personal protective equipment available and correctly used, maintained, and stored?	☐	☐	☐
12. Is the following emergency equipment located at each site:	☐	☐	☐
• Fire extinguisher?	☐	☐	☐
• Eye wash (minimal)?	☐	☐	☐
• Communications (walkie talkie or phone)?	☐	☐	☐
• First aid kit?	☐	☐	☐
13. Is the buddy system in use?	☐	☐	☐
14. Are personnel refraining from drinking, chewing, smoking, taking medications, or other hand-to-mouth contact while working in the exclusion zone?	☐	☐	☐
15. Is the site organized to allow the use of lifting equipment, and avoid tripping hazards and spreading contamination?	☐	☐	☐
16. Was a random employee asked if he/she know site hazard and emergency procedures?	☐	☐	☐

The QC Inspector shall sign this checklist upon completion of all items on the checklist.

QC Inspector Signature:

Date:

EA Engineering, Science, and Technology, Inc.

DAILY SAFETY INSPECTION CHECKLIST
(TO BE COMPLETED EACH DAY OF CONSTRUCTION OR HTRW SITE ACTIVITIES)

Site: ____________________ Prepared by SSHO: ____________________

Location: ____________________

Project No.: ____________________ Project Manager: ____________________

Client: ____________________ Date : ____________________

Rating	Y	N	N/A	Comments/Immediate Corrective Action[1]
Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) General Requirements				
Are there new onsite personnel? • Did they receive pre-entry briefing and are their names recorded in field logbook or daily log? • Was the USACE PM made aware of the new personnel. • Required training and medical surveillance documentation received (e.g., 40-hr, 8 hr, etc.)?				
Did personnel sign in/out of site?				
Daily tailgate safety meetings conducted and documented?				
Were new activities performed today? Were hazards identified, discussed during the daily safety tailgate, and incorporated into revised APP/SSHP?				
New materials brought on site? MSDSs available?				
Exclusion (EZ), Contamination Reduction (CRZ), and Support Zones (SZ) delineated and enforced?				
General housekeeping measures in place to prevent hazards?				
Emergency Planning				
Were there any changes to emergency contact names, telephone numbers, or hospital? If so, were site personnel made aware and was information distributed/reposted.				
Adequate safety equipment inventory available?				
Fire extinguisher available (monthly inspection of extinguisher will suffice)				
Eyewash station(s) functioning and in place (weekly inspection of eye wash station will suffice)?				
First aid supplies available (weekly inspection of first aid kit will suffice)?				
Communication equipment readily available for emergencies?				
Any reported accidents/incidents at this site? If so, were accident reporting procedures followed?				
Air Monitoring				
Monitoring equipment specified in SSHP available and in working order? Air monitoring instrumentation for this site includes – check each if required/on site, note deficiencies in comments: • Combustible gas meter • Organic vapor analyzer • Contaminant specific analyzer for benzene (if total organic vapor concentrations exceed 0.5 ppm)				
Monitoring equipment calibrated and calibration records				

Y = Satisfactory or Yes; N = Unsatisfactory or No, N/A = Not applicable

Rating	Y	N	N/A	Comments/Immediate Corrective Action[1]
available?				
Environmental and personnel monitoring performed as specified in SSHP?				
PPE				
Proper dermal protection worn by EA and subcontracted employees when handling/ contacting hazardous chemicals or contaminated environmental media?				
Required PPE (hard hats, safety boots / shoes, eye protection with side shields, hearing protection) being worn by EA and subcontracted employees?				
PPE inspection completed by SSHO?				
Drill Rig Operations				
Daily rig inspection completed? Any equipment problems?				
Drill rigs/elevated equipment maintaining minimum 10-ft distance from energized (50 kV) overhead power lines?				
Investigation-derived Waste (IDW)				
Wastes properly staged, secured, and labeled at end of day?				

Additional Comments:

____
Site Safety and Health Officer's Signature

____
Date

[1]If a deficiency is noted that cannot be immediately corrected, the SSHO will monitor the progress in correcting the deficiency and will document following:

- Date the deficiency was identified
- Description of the deficiency
- Name of the person responsible for correcting the deficiency
- Projected date of correction
- Actual date of correction.

EA Engineering, Science, and Technology, Inc.

INITIAL SAFETY INSPECTION CHECKLIST
(TO BE COMPLETED FIRST DAY OF SITE ACTIVITIES)

Site: ____________________ Prepared by SSHO: ____________________
Location: ____________________
Project No.: ____________________ Project Manager: ____________________
Client: ____________________ Date : ____________________

Rating	S	U	N/A	Comments/Immediate Corrective Action[1]
Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) General Requirements				
Was a pre-entry safety briefing conducted? If so, did it include the following: • Site personnel and roles and authority to stop work? • Competent person(s) for identifying hazards? • Disclosure of potential hazards? • Emergency response procedures including rally point, contacts, location and directions of nearest medical support (hospital)? • Use of fire extinguishers • Vehicle rules/regulations? • Equipment to be used and those personnel qualified to use the equipment? • Methods of decontamination? • Storing/staging of wastes and materials? • Location/use of Material Safety Data Sheets (MSDS)? • Site control, including requirements for documenting entry into the site and procedures for entry and exit into work zones? • Task specific personal protective equipment (PPE) requirements? • Applicable standard operating procedures? • Environmental monitoring requirements and action levels? • Responsibilities for safety of personnel/property? • Safe work practices? • Procedures for maintaining personnel and site sanitation?				
Approved APP/SSHP on site?				
APP/SSHP compliance agreement form signed by onsite personnel, including subcontractors?				
New activities or hazards identified and incorporated into revised APP/SSHP?				
Names of onsite personnel recorded on site sign in sheet?				
Applicable MSDSs on site or available?				
Hazard labeling practices currently being used?				
Records of daily inspections available for review?				
Daily tailgate safety meetings conducted and documented?				
Onsite personnel meet SSHP requirements for medical examinations, fit testing, and training (including subcontractors)?				
Documentation of training, medical examinations, and fit tests available from employer (as applicable)?				
Compliance with specified safe work practices?				
Exclusion (EZ), Contamination Reduction (CRZ), and Support				

Rating	S	U	N/A	Comments/Immediate Corrective Action[1]
Zones (SZ) delineated and enforced?				
Windsock, flag, or ribbons in place to indicate wind direction?				
SZ located upwind from EZ and CRZ, as practicable?				
Emergency Planning				
Emergency telephone numbers posted?				
Emergency telephone numbers up to date?				
Emergency route to hospital posted?				
Local emergency providers notified of site activities?				
Fire extinguisher on site, of adequate size, and inspected within past month?				
Review weather emergency procedures?				
Adequate safety equipment inventory available?				
First aid provider and first aid supplies available?				
Eyewash station(s) functioning and in place?				
Communication equipment readily available for emergencies?				
Any reported accidents/incidents at this site? If so, are the accident/incident reports available for review?				
Air Monitoring				
Monitoring equipment specified in SSHP available and in working order (See Instrumentation list below)?				
Monitoring equipment calibrated and calibration records available?				
Personnel know how to operate monitoring equipment and equipment manuals available on site?				
Environmental and personnel monitoring performed as specified in SSHP?				
Air monitoring instrumentation includes: • Combustible gas meter? • Organic vapor analyzer?				
PPE (SSHO to enforce PPE requirements for EA and subcontractor employess)				
Proper dermal protection worn when handling/ contacting hazardous chemicals or contaminated environmental media?				
Required PPE (hard hats, safety boots / shoes, eye protection with side shields) being worn?				
PPE inspection completed by SSHO?				
Hearing protection available? Worn when required?				
Heavy Equipment Operations				
Equipment operators experienced/properly trained?				
Dust control measures implemented in EZ, as necessary?				
Equipment regularly inspected and maintained?				
Utility lines located and marked prior to construction activities?				
Clearance/digging permits kept onsite and available for review?				
Drill rigs/elevated equipment maintaining minimum 10-ft distance from energized (50 kV) overhead power lines?				
When backing a vehicle up is a spotter used?				
Supplies				

S = Satisfactory; U = Unsatisfactory, N/A = Not applicable

Rating	S	U	N/A	Comments/Immediate Corrective Action[1]
Decontamination equipment and supplies on site?				
Fire extinguishers (functioning, inspected, and in field vehicles)?				
Spill cleanup supplies on site?				
Investigation-derived Waste (IDW)				
Wastes properly disposed of?				
Designated location for drummed IDW?				
IDW containers properly labeled?				

Additional Comments:

____
Site Safety and Health Officer's Signature

____
Date

[1]If a deficiency is noted that cannot be immediately corrected, the SSHO will monitor the progress in correcting the deficiency and will document following:
- Date the deficiency was identified
- Description of the deficiency
- Name of the person responsible for correcting the deficiency
- Projected date of correction
- Actual date of correction.

SAFETY INSPECTION REPORT (D-3)

Site / Location: ___________________________ Date: ____/____/____

Type of Inspection: ____ Daily ____ Weekly ____ Re-Inspection ____ Other

Type of Operation Inspected:

____

____

Equipment Inspected: (Specify if Safety or Operational in Nature)

____

____

____

____

____

Comments:

____

____

____

____

____

Deficiencies Found or Noted:

____

____

____

Corrective Action:

____

____

____

Re-Inspection Required: ____ Yes ____ No If Yes, Date of Re-Inspection: ____/____/___

Signature: _______________________________ ___________________________________

SO SUXOS / Project Manager

* Copy to Supervisor if Deficiencies or Corrective Action were found, noted or deemed necessary.

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Form D-6

(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 Suppl to AR 385-40)*	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 *(month/day/year)*
b. TIME OF ACCIDENT *(Military time)* hrs
c. EXACT LOCATION OF ACCIDENT
d. CONTRACTOR'S NAME
(1) PRIME:
(2) SUBCONTRACTOR:

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)*
____

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
PRIMARY ________ (CODE) #
SECONDARY ________ (CODE) #

f. NATURE OF ILLNESS/INJURY ________ (CODE) #

g. TYPE AND SOURCE OF INJURY/ILLNESS
TYPE ________ (CODE) #
SOURCE ________ (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 FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE
☐ PICKUP/VAN ☐ AUTOMOBILE
☐ TRUCK ☐ OTHER *(Specify)*
____

b. TYPE OF COLLISION
☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END
☐ BROADSIDE ☐ ROLL OVER ☐ BACKING
☐ OTHER *(Specify)* ________

c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
(1) FRONT SEAT			
(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. TYPE OF VESSEL/FLOATING PLANT ________ (CODE) #
b. TYPE OF COLLISION/MISHAP ________ (CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*					
a. (Explain YES answers in item 13)	YES	NO	a. *(CONTINUED)*	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐	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?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐	OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐	SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐	PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐	DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐	b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?		
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐	☐ YES *(If yes, attach a copy.)* ☐ NO		

12. TRAINING		
a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

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

b. INDIRECT CAUSE(S)

14. **ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).**

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.			
a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)		
c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT CORPS ____________ CONTRACTOR ____________	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL

16. **MANAGEMENT REVIEW** *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. **MANAGEMENT REVIEW** *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. **SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW**

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. **COMMAND APPROVAL**

COMMENTS

COMMANDER SIGNATURE	DATE

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

U.S. Army Corps of Engineers
Safety Inspection Checklist
Drilling Equipment

Date of Inspection	
Location (Plant or Facility)	Contract Number
Contractor Name	Project Name
Inspector Name (Print)	Inspector Signature

This checklist serves as a guide only, it does not replace or eliminate the need to comply with the requirements set forth in Engineering Manual 385-1-1, Safety and Health Requirements Manual, dated 15 September 2008. The references included in this checklist correspond to the applicable sections of EM 385-1-1.

Item Description	REF	Yes	No	N/A	Remarks (Any NO or N/A item)
1. Is drilling equipment operated, inspected, and maintained as specified in the manufacturer's operating manual?	18.H.02				
2. Is a copy of the manual for all drilling equipment available?	18.H.02				
3. Has a survey been conducted to identify overhead electrical hazards and potential ground hazards and their locations identified in the site layout plan?	18.H.03				
4. Are all findings of the survey a part of the AHA?	18.H.03.b				
5. Does the AHA contain copies of Material Safety Data Sheets for all drilling fluids available?	18.H.03.a				
6. Have all members of the drilling crew been trained the operation, inspection, and maintenance of the equipment; the safety features and procedures to be used; and overhead electrical lines and underground hazards?	18.H.05				
7. Does the drilling equipment have two easily accessible emergency shut down devices (one for the operator and one for the helper)?	18.H.06				
8. Is the equipment posted with a warning of electrical hazards?	18.H.07				
9. Is there a spotter or an electrical proximity warning device available to ensure safe distances from power lines are maintained?	18.H.07.b				
10. Before moving earth drilling equipment, has the travel route been surveyed for overhead and terrain hazards, particularly overhead electrical hazards, mast lowered?	18.H.08				
11. Is equipment set-up in a stable manner, with cribbing if necessary?	18.H.09				
12. Are outriggers being used in accordance with the manufacturer's recommendations, if drilling is in confined space are requirements of 34A followed?	18.H.09				
13. Are drill rigs properly secured/identified when parked on highway or shoulder?	18.H.10				
14. Are drill crew members prohibited from wearing loose clothing, jewelry, or equipment which might become caught in moving machinery?	18.H.11.b				

U.S. Army Corps of Engineers
Safety Inspection Checklist
Drilling Equipment

Date of Inspection

Item Description	REF	Yes	No	N/A	Remarks (Any NO or N/A item)
15. Are slip rings or other rod slipping devices on the drill?	18.H.11.h				
16. Are steps being taken to control dust?	18.H.11.i				
17. Are augers cleaned only when the rotating mechanism is in neutral and the auger is stopped?	18.H.11.j				
18. Are augers guarded?	18.H.11.j				
19. Are open bore holes capped and flagged?	18.H.11.k				
20. Are open excavations barricaded?	18.H.11.k				

Other Remarks

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 descretion 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-0810/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	**14. ELECTRICAL**
2. SITE PREPARATION	**15. SCAFFOLDING/ACCESS**
3. EXCAVATION/TRENCHING	**16. MECHANICAL**
4. GRADING (EARTHWORK)	**17. PAINTING**
5. PIPING/UTILITIES	**18. EOUIPMENT/MAINTENANCE**
6. FOUNDATION	**19. TUNNELING**
7. FORMING	**20. WAREHOUSING/STORAGE**
8. CONCRETE PLACEMENT	**21. PAVING**
9. STEEL ERECTION	**22. FENCING**
10. ROOFING	**23. SIGNING**
11. FRAMING	**24. LANDSCAPING/IRRIGATION**
12. MASONRY	**25. INSULATION**
13. CARPENTRY	**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	13. DUMP TRUCK (OFF HIGHWAY)
2. DRAGLINE	14. TRUCK (OTHER)
3. CRANE (ON VESSEL/BARGE)	15. FORKLIFT
4. CRANE (TRACKED)	16. BACKHOE
5. CRANE (RUBBER TIRE)	17. FRONT-END LOADER
6. CRANE (VEHICLE MOUNTED)	18. PILE DRIVER
7. CRANE (TOWER)	19. TRACTOR (UTILITY)
8. SHOVEL	20. MANLIFT
9. SCRAPER	21. DOZER
10. PUMP TRUCK (CONCRETE)	22. DRILL RIG
11. TRUCK (CONCRETE/TRANSIT MIXER)	23. COMPACTOR/VIBRATORY ROLLER
12. DUMP TRUCK (HIGHWAY)	24. OTHER

INSTRUCTIONS FOR SECTION 5 - INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY/ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI	**NO INJURY**
FAT	**FATALITY**
PTL	**PERMANENT TOTAL DISABILITY**
PPR	**ERMANENT PARTIAL DISABILITY**
LWD	**LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK**
NLW	**RECORDABLE CASE WITHOUT LOST WORKDAYS**
RFA	**RECORDABLE FIRST AID CASE**

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

GENERAL BODY AREA	CODE	BODY PART NAME
HEAD, EXTERNAL	**H1**	**EYES 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, BUTTOCK	**LB**	**BOTH LEGS/HIPS/ ANKLES/BUTTOCKS**
	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 <u>which occurred during a single work day or shift.</u>**

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**
	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 <u>repeated exposures to conditions of the work environment over a long period of time</u>. 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, OCCU- PATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRON-MENTAL 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)

CODE	TYPE OF INJURY NAME
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

CODE	SOURCE OF INJURY NAME
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, byproducts 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 the month, day, and year 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 when the corrective action(s) identified in section 14 will begin.

b. **COMPLETE DATE** - Enter the date when the corrective action(s) identified in section 14 will be completed.

c. **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 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for mangement review as indicated in section 16.

d. **DATE SIGNED** - Enter the month, day, and year that the report was signed by the responsible supervisor.

e. **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 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. **OFFICE SYMBOL** - Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

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 15.c 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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SAFETY AUDIT CHECKLIST

Site:	______________________	Prepared by:	______________________
Location:	______________________	Audit Date:	______________________
Project No.:	______________________	Project Manager:	______________________
Client:	______________________	Site Safety and Health Officer :	______________________

Rating	S	U	N/A	Comments
Site Safety and Health Plan (SSHP) General Requirements				
Was a pre-entry safety briefing conducted? If so, did it include the following: • Disclosure of potential hazards? • Procedures for clearances/entry to restricted areas? • Emergency response? • Vehicle rules/regulations? • Equipment to be used? • Material handling restrictions? • Transporting/storing hazardous materials? • Personal protective equipment (PPE)? • Applicable standard operating procedures? • Methods of decontamination? • Responsibilities for safety of personnel/property? • Location/use of Material Safety Data Sheets (MSDS)? • Safe work practices?				
Approved SSHP on site?				
SSHP compliance agreement form signed by onsite personnel, including subcontractors?				
New activities or hazards identified and incorporated into revised SSHP?				
Names of onsite personnel recorded in field logbook or daily log?				
Applicable MSDSs on site or available?				
Hazard labeling practices currently being used?				
Designated Site Safety and Health Officer (SSHO) present? • Designated alternate SSHO? • SSHO conducts daily inspections of site/work zones? • Records of daily inspections available for review?				
Daily tailgate safety meetings conducted and documented?				
Onsite personnel meet SSHP requirements for medical examinations, fit testing, and training (including subcontractors)?				
Documentation of training, medical examinations, and fit tests available from employer (as applicable)?				
Compliance with specified safe work practices?				
Exclusion (EZ), Contamination Reduction (CRZ), and Support Zones (SZ) delineated and enforced?				
Windsock, flag, or ribbons in place to indicate wind direction?				
SZ located upwind from EZ and CRZ, as practicable?				
Emergency Planning				
Emergency telephone numbers posted?				
Emergency telephone numbers up to date?				

S = Satisfactory; U = Unsatisfactory, N/A = Not applicable

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Rating	S	U	N/A	Comments
Emergency route to hospital posted?				
Local emergency providers notified of site activities?				
Review weather emergency procedures?				
Adequate safety equipment inventory available?				
First aid provider and first aid supplies available?				
Eyewash station(s) functioning and in place?				
Communication equipment readily available for emergencies?				
Any reported accidents/incidents at this site? If so, are the accident/incident reports available for review?				
Air Monitoring				
Monitoring equipment specified in SSHP available and in working order (See Instrumentation list below)?				
Monitoring equipment calibrated and calibration records available?				
Personnel know how to operate monitoring equipment and equipment manuals available on site?				
Environmental and personnel monitoring performed as specified in SSHP?				
Heat stress monitoring being conducted and “cool-down” breaks implemented?				
Air monitoring instrumentation includes: • Combustible gas meter? • Oxygen meter? • Organic vapor analyzer? • Hydrogen sulfide monitor				
PPE				
Proper dermal protection worn when handling/ contacting hazardous chemicals or contaminated environmental media?				
Required PPE (hard hats, safety boots / shoes, eye protection with side shields) being worn?				
Personal flotation device (PFD) available? Worn when required?				
Reflective vests available? Worn when required?				
Hearing protection available? Worn when required?				
Heavy Equipment Operations				
Equipment operators experienced/properly trained?				
Dust control measures implemented in EZ, as necessary?				
Equipment regularly inspected and maintained?				
Utility lines located and marked prior to construction activities?				
Clearance/digging permits kept onsite and available for review?				
Drill rigs/elevated equipment maintaining minimum 10-ft distance from energized (50 kV) overhead power lines?				
Traffic control barricades in place (28-in traffic cones/flags/barricade tape)?				
Proper PPE, including hearing protection/reflective vests used?				
When backing a vehicle up is a spotter used?				

S = Satisfactory; U = Unsatisfactory, N/A = Not applicable

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Rating	S	U	N/A	Comments
Working Near Water/Wastewater Treatment Areas				
In areas lacking guardrails, wearing PFDs?				
Buddy system in place and observed?				
Supplies				
Decontamination equipment and supplies on site?				
Fire extinguishers (functioning, inspected, and in field vehicles)?				
Spill cleanup supplies on site?				
Power Tools/Electrical Hazards				
Proper PPE used?				
Lock-out/Tag-out system in place and observed?				
Power tools and power cords inspected and maintained?				
Investigation-derived Waste (IDW)				
Wastes properly disposed of?				
Designated location for drummed IDW?				
IDW containers properly labeled?				

Additional Comments:

Auditor's Signature

Site Safety and Health Officer's Signature

Date

Date

S = Satisfactory; U = Unsatisfactory, N/A = Not applicable

10.	ACCIDENT DESCRIPTION *(Continuation)*

13a.	DIRECT CAUSE *(Continuation)*

13b. **INDIRECT CAUSES** *(Continuation)*

14. **ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S)** *(Continuation)*

Appendix E

Site Safety and Health Plan

REVISION 1
SITE SAFETY AND HEALTH PLAN

MILITARY MUNITIONS RESPONSE PROGRAM AND HAZARDOUS TOXIC AND RADIOACTIVE WASTE SITES REMEDIAL INVESTIGATION THROUGH DECISION DOCUMENT AT THE IONA ISLAND NAVAL AMMUNITION DEPOT FORMERLY USED DEFENSE SITE, ROCKLAND COUNTY, NEW YORK

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LIST OF ACRONYMS AND ABBREVIATIONS

°mg/m3	Milligram per cubic meter
%	Percent
°F	Degrees Fahrenheit
ABIH	American Board of Industrial Hygiene
AHA	Activity hazard analysis
AL	Action Level (OSHA)
ANSI	American National Standards Institute
AOC	Area of concern
APP	Accident prevention plan
BZ	Breathing zone
C	Ceiling limit
Ca	Carcinogen
CNS	Central nervous system
CIH	Certified Industrial Hygienist
COPC	Contaminant of potential concern
CNS	Central nervous system
CPR	Cardiopulmonary resuscitation
CSP	Certified Safety Professional
DD	Decision document
DMM	Discarded Military Munitions
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc., PBC
ESP	Explosives Site Plan
f/cc	Fibers per cubic meter
ft	Foot (feet)
FUDS	Formerly Used Defense Site
GIS	Geographic information system
HFD	Hazard fragment distance
HTRW	Hazardous Toxic and Radioactive Waste
IDHL	Immediately dangerous to life and health
IFV	Inhalable fraction and vapor
in.	Inch(es)
MC	Munitions constituents
MD	Munitions debris

MEC	Munitions and explosives of concern

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

MMRP	Military Munition Response Program
MPPEH	Munitions potentially presenting an explosive hazard
MRS	Munitions Response Site
N.D.	Not determined
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PEL	Permissible Exposure limit
PPE	Personal protective equipment
ppm	Parts per million
RI	Remedial investigation
SHM	Safety and Health Manager
SSHP	Site Safety and Health Plan
SSHO	Site Safety and Health Officer
STEL	Short term exposure limit (15 min)
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	Semi-volatile organic compound
TLV	Threshold limit level
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

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1. SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

This Site Safety and Health Plan (SSHP) has been prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) to support the Military Munition Response Program (MMRP) and Hazardous Toxic and Radioactive Waste (HTRW) Remedial Investigation (RI) through Decision Document (DD) for the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS), Rockland County, New York. Section 2.2 provides "Phases of Work" in the Accident Prevention Plan (APP). USACE is conducting work at the site under the Defense Environmental Restoration Program for FUDs using the processes under the Comprehensive Environmental Response, Compensation, and Liability Act. The FUDS program cleans up only Department of Defense (DoD)-generated eligible contamination, which occurred before the transfer of the property to private owners or federal, state or local governments. There are three FUDS projects at the former Iona Island Naval Ammunition Depot FUDS:

- C02NY074401 Containerized Hazardous Toxic and Radioactive Waste (CON/HTRW)
- C02NY074402 HTRW
- C02NY074403 Military MMRP.

This SSHP addresses the FUDS MMRP and HTRW project categories. The FUDS CON/HTRW was closed out in 2012.

The FUDS MMRP includes one Munitions Response Site (MRS), MRS-01 1903 Explosion area (approximately 124.2 acres of land and inland water. MRS-01 extends beyond the FUDS boundary (Figure 2-1 of the APP). Historical records include several reports of ordnance items found within the FUDS and identify the potential for additional ordnance items, including Munitions and Explosives of Concern (MEC), Munitions Debris (MD), and discarded military munitions (DMM), to be found within the FUDS. Anecdotal evidence identifies the potential for DMM around and/or downstream of three former loading docks, where munitions may have been dropped into the Hudson River during the loading and unloading of supply vessels. Additionally, several potential MEC items have been reportedly sighted in low-tide conditions in an area of Round Island referred to as a "dump site" (Alion 2008).

The FUDS HTRW includes and 19 Areas of Concern (AOCs) located in the footprints of former site facilities (Figure 2-1 of the APP). Historical DoD activities at the AOCs may have resulted in the release of contaminants to environmental media (surface soil, subsurface soil, sediment, and groundwater) at concentrations that may pose a risk to human health and ecological receptors.

1.1 SITE LOCATION AND BACKGROUND

The Iona Island Naval Ammunition Depot FUDS is located along the Hudson River on Iona Island and Round Island in the town of Stony Brook, Rockland County, New York, and consists of approximately 118–129 acres of land and inland water. The Depot was actively used by the U.S. Naval Department for ammunition storage for approximately 50 years, from 1900 to 1947. During

Navy use, site activities reportedly included preparing, assembling, maintaining, inspecting, testing, and issuing ammunition, but did not include manufacturing activities (Alion 2008). An explosion in 1903 former Building Numbers 209 and 210, originating from the approximate center of the Depot at former Building Numbers 209 and 210, is thought to have thrown stored ammunition shells as far as 1,250 feet from the blast.

Investigations have been ongoing at Iona Island since 1992 and include:

- 1992—USACE performed an initial site visit and produced a Preliminary Assessment which identified the potential for groundwater and soil contamination near former buildings, aboveground storage tanks, paint and coal storage, dump area, and incinerator locations based on historical use (Bluestone 2018).

- 1995—USACE produced a Revised Site Survey Summary Sheet, listing several remaining structures as beneficially used by the present owner (Bluestone 2018).

- 1996—USACE contractor (Greeley-Polhemus Group, Inc. and Smith Technology Corporation) conducted surface soil sampling at AOCs identified by USACE. Metals, semi-volatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs) were identified in samples; metals were determined to be the primary contaminant of environmental concern. The report recommended a site risk evaluation and additional sampling to further delineate metals and SVOC contamination (Greeley-Polhemus Group, Inc. 1997).

- 1997—USACE completed an Archive Search Report documenting archival information and interviews with site personnel. USACE also performed a site visit; no hazards were discovered during the inspection (USACE 1998).

- 2007—USACE contractor (Alion Science and Technology Corporation and EA [subcontractor]) conducted an MMRP Site Inspection, which included sampling for munitions constituents (MC) and a qualitative site reconnaissance. The site reconnaissance was performed at low tide along the shoreline near former dock areas and the Dumping Area; no MD or MEC were observed. Potential human and ecological risks from MC were identified in sediment samples. The Final Site Investigation Report recommended further action (RI/Feasibility Study) for both MEC and MC (Alion 2008).

- 2011—USACE contractor (Green Seal Environmental, Inc.) conducted a geophysical survey to identify and remove underground storage tanks (USTs). Two USTs were identified and removed. Based on the condition of the USTs and the results of the confirmation soil sampling, soil remediation was not required (Green Seal, Inc. 2012).

- 2017—USACE prepared a FUDS Interim Risk Management Communication Assessment Summary to assess whether additional public safety outreach is necessary. USACE concluded that landowner notification letters were sufficient; one landowner notification letter with a project safety guide was mailed, no calls were received by the toll-free information center (USACE 2017).

- 2018—The U.S. Army Geospatial Center performed a Historical Photographic Analysis of the Former Iona Island Naval Ammunition Depot FUDS on behalf of USACE New England and Baltimore Districts. Historical aerial photography, documents (including text, tables, photographs, and maps), design drawings, and disposal data from 1931 to the present was used to locate and identify former buildings that may be related to hazard toxic and radioactive waste. Data generated during the analysis is summarized in a September 2018 report and is compiled in a Geographic Information System (GIS) package (USAGC 2018).

1.2 CONTAMINANT CHARACTERIZATION

Based on historical information and previous investigations, potential MEC present at Iona Island include:

- 1-pounder, 6-pounders, 6-inch (in.) and 13-in. ammunition distributed throughout MRS-01 land, water or wetland areas from the 1903 explosion at former Building Numbers 209 and 210

- DMM within the FUDS property boundary (including within MRS-01)

- DMM in water near or downstream of the former loading docks in the Hudson River

- DMM in the previously identified “dump site” between Iona Island and Round Island

- DMM adjacent to former or existing munitions storage igloos and gun positions.

Potential contaminants associated with MEC include MEC and lead associated with breached items potentially in soil and sediment .

Environmental samples collected during surface soil sampling activities (Greeley-Polhemus Group, Inc. 1997) and the 2007 MMRP Site Inspection (Alion 2008), reported metals (particularly lead) and semivolatile organic compounds (SVOCS) (primarily polycyclic aromatic hydrocarbons [PAH]) in soil and sediment at concentrations above applicable screening criteria. Metals and SVOCs have therefore been identified as COPCs for 16 HTRW AOCs. VOCs have been identified as COPCs for former AST AOCs.

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2. HAZARD/RISK EVALUATION

The primary work phases are described in Section 2.2 of the APP. Each task has been analyzed to assess the potential safety, chemical, physical, and biological hazards that may be encountered by site personnel and prescribe the proper engineering and/or administrative controls and/or personal protective equipment (PPE). These controls will ensure that the risks to site personnel safety and health are reduced or eliminated while performing the project. The results of the task hazard analysis are documented using a task-specific Activity Hazard Analysis (AHA). An AHA has been developed for each task associated with this project. **Table 2-1** summarizes the site-specific hazard evaluation for each task. The AHAs are provided in Appendix A of the APP. The primary hazard groups of concern associated with this site are as follows:

- Chemical hazards
- General physical hazards
- Fire/explosion hazards
- Hand and power tools
- Heavy equipment hazards (mini excavator)
- Utilities
- Weather hazards
- Material handling/moving/lifting hazards
- Biological hazards
- MEC hazards
- Small boating hazards
- Diving conditions.

2.1 CHEMICAL HAZARDS

The potential for exposure to chemical hazards may occur during intrusive investigation and waste management activities. Potential site chemicals are identified on **Table 2-2** based on the contaminant characterization presented in Section 1.2 and chemicals to be used onsite. Section 7 presents the exposure limits, routes of exposure, and symptoms of exposure for chemicals of potential concern that may be present at this site. It should be noted that gasoline and diesel may be used during the completion of work tasks and are not related to the FUDS site. Control of chemical hazards will include the use of PPE and proper hygiene practices for dermal contact with engineering controls to reduce and/or eliminate exposure through inhalation.

Dermal contact with chemical hazards is possible. Many hazardous chemicals are readily absorbed through the skin. Therefore, dermal protection appropriate for the chemical will be worn when handling or contacting potentially contaminated environmental media (Chapter 5).

2.2 GENERAL PHYSICAL HAZARDS

Field operations at the site may include many general physical hazards, such as:

- Holes, ditches, marshes with water filled depressions and channels.
- Precariously positioned objects, which may cause crushing or other injuries (e.g., hand tools, field equipment, safety equipment)
- Sharp objects (e.g., metal shards, debris or trash in the woods, hydraulic lines in vehicles) that may cause cuts, injection, or other injuries
- Slippery surfaces, posing slip and fall hazards (e.g., boat decks)
- Uneven terrain, posing slip, trip, and fall hazards (all activities)
- Unstable surfaces (e.g., wetlands) that may pose fall, or other injuries.

Site personnel will look constantly, closely, and carefully for these basic safety hazards and inform the Site Safety and Health Officer (SSHO) of conditions that may present a hazard. If hazards are present, these hazards will be recorded by the SSHO and discussed in daily briefings. Precautionary measures will be taken to prevent injury. Materials handling can vary from heavy equipment handling to manually moving/lifting items. Hazards associated with materials handling at MRS-01 and the 19 AOCs may cause physical injury.

Physical injuries to back and abdominal muscles from improperly lifting of loads are the most common occupational injuries reported. Such injuries can range from relatively mild strains to major, permanently disabling injuries. Before lifting a load (e.g., sample coolers, field equipment), personnel will consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Workers will lift with their legs, keeping their back straight, keep the load close to their body, not twist while lifting, and not lift more than 50 pounds.

2.3 FIRE/EXPLOSION HAZARDS

Section 9.11 in the APP discusses the Fire Prevention and Protection Plan and the associated fire and explosion hazards.

2.4 HEAVY EQUIPMENT HAZARDS

The use of heavy equipment (e.g., mini-excavators) may pose safety hazards to site workers during excavation. Heavy equipment work will be conducted only by trained, licensed (as required by state law), and experienced personnel. Site workers will remain outside the turning radius of moving equipment and will maintain visual contact with the equipment operator to prevent harm from collisions between heavy equipment and site personnel.

No personnel are permitted to work underneath heavy equipment or hoisted loads because this practice poses a serious crushing hazard. Personnel must remain 25 ft or more from equipment when in use. Belts, pulleys, sheaves, gears, chains, shafts, clutches, drums, flywheels, and other moving parts (internal or external) of equipment can pose injury hazards. Site personnel are prohibited from approaching the gears/belts/pulleys of equipment when the equipment is operating to prevent physical harm in the form of abrasions, lacerations, or other physical harm.

Exhaust from equipment powered by combustion engines (no steam engines will be onsite) will be properly located so that release of exhaust does not endanger workers or obstruct the view of the operator. Gasoline-operated equipment (vehicles and heavy equipment) will be re-fueled properly to prevent fire hazards; power will be off, no smoking allowed, and proper dispensing equipment will be used (fire extinguishers nearby and self-locking cans or other approved dispensers will be used if not filled at a stand-alone commercial gas station). Additionally, USACE-approved spill kits will be present when refilling fuel containers onsite. When not operational, equipment (stated above and listed specifically in the AHAs in Appendix A of the APP) will be set and locked so that it cannot be activated, released, dropped, etc.

2.5 UTILITIES

The SSHO will be responsible for ensuring that the utility locating service has completed a utility marking for the site prior to site intrusive work. These markings show an estimated location of underground installations, including sewer, telephone, fuel, electric, water lines or other underground installations that reasonably may be expected to be encountered during invasive work. Site maps and site-specific knowledge from Palisades Interstate Park Commission personnel will also be utilized when available to note underground hazards. Use of a pipe and cable locator or metal detector may also be necessary to accomplish locating these hazards. The following are the utility clearance phone numbers for Dig Safely New York:

811 or 1-800-962-7962.

Underground utilities pose hazards to workers involved in invasive operations such as excavating, drilling, and direct-push sampling. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, and water lines. Prior to commencement of invasive operations, underground utilities, including buried wires, pipes, tanks, etc., will be visibly marked with flags or marking paint to alert workers to areas unsafe for digging/excavating. Personnel will be aware that although an area may be “cleared,” unanticipated hazards may occur. Intrusive subsurface work will be located at least 3 ft from utility markings.

Workers will be alert for unanticipated events such as snapping cables, excavation into unmarked underground utilities, etc. Such occurrences will prompt involved individuals to halt work immediately and take appropriate corrective measures to gain control of the situation.

2.6 HAND AND POWER TOOLS

An AHA for hand tool use is provided in Appendix A of the APP.

- **Use, Inspection, and Maintenance:**

  - Tools failing inspection will not be used.

  - Impact tools, such as chisels, will be kept free of mushroomed heads.

  - Wooden handles will be kept free of splinters or cracks and will be kept tight in the tool.

  - Hand and power tools will be used, inspected, and maintained in accordance with the manufacturer's instructions and recommendations and will be used only for the purpose for which designed.

  - Hand and power tools will be inspected, tested, and determined to be in safe operating condition before use; continued periodic inspections will be made to ensure safe operating condition and proper maintenance.

  - Hand and power tools will be in good repair and with all required safety devices installed and properly adjusted; tools having defects that will impair their strength or render them unsafe will be removed from service.

  - Electric power-operated tools will be double insulated or properly grounded.

- **Guarding:**

  - Power tools designed to accommodate guards will be equipped with such guards.

  - Portable power-driven circular saws will be equipped with guards above and below the base plate or shoe. When the tool is withdrawn from work, the lower guard will automatically and instantly return to the covering position.

- **Switches:**

  - All hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels greater than 2 in. in diameter, disc sanders, belt sanders, reciprocating saws, saber saws, and other similar operating powered tools shall be equipped with a momentary contact "on-off" control and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

— All other hand-held powered tools, such as circular saws, chain saws, and percussion tools without positive accessory holding means, shall be equipped with a constant pressure switch that will shut off the power when the pressure is released.

- **PPE:**

— Loose and frayed clothing, loose long hair, dangling jewelry (including dangling rings, chains, earrings, and wristwatches) will not be worn while working with power tools.

— Employees using hand and power tools and exposed to the hazard of falling, flying, abrading, and splashing objects, or exposed to harmful dust, fumes, mists, vapors, or gases will be provided with the PPE necessary to protect them from the hazard.

2.7 WEATHER HAZARDS

To safely mitigate the hazards from severe weather (i.e., heavy rains, electrical storms, or heavy snowfall), site personnel (including the SSHO) will look for indications of impending severe weather (e.g., changes in wind direction, cloud formation, or humidity) and monitor weather conditions online using a weather station that is part of the National Oceanic and Atmospheric Administration (NOAA) weather radio network. If severe weather is likely, based on weather review, site personnel will retreat to their support vehicle. If site personnel observe lightning within 6 miles of the project site, as based on a lightning detector, NOAA radio application, and/or a lightning strike map monitored by the SSHO, all site activity will be halted immediately. The SSHO will monitor weather conditions, and activity will not resume for 30 minutes following cessation of severe weather. The SSHO is responsible for providing site personnel notification that work may resume. Hazards associated with heat stress and cold stress are described in Chapter 8. Weather hazards related to vessel operations are included in Appendix G of the APP.

2.8 MATERIAL HANDLING/MOVING/LIFTING HAZARDS

Material handling at hazardous waste sites can vary from heavy equipment handling to manually moving/lifting items. Hazards associated with material handling include physical injury, detonation, fire, explosion, and vapor generation among others. Injuries to back and abdominal muscles from improperly lifting of loads are the most common occupational injuries reported. Such injuries can range from relatively mild strains to major, permanently disabling injuries. Before lifting a load, personnel will consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Loads anticipated to be moved during activities at the Iona Island FUDS include coolers, samples, sampling equipment, general hand tools, and health and safety equipment. When using equipment to move materials, proper work practices will be followed, and equipment used will be designed for the task to be performed. Equipment will be inspected in accordance with the requirements presented in Chapter 7 of the APP.

2.9 BIOLOGICAL HAZARDS

A survey of the potential biological hazards (harmful plants, animals, insects, and marine life) was conducted for work areas at the Iona Island FUDS. The results are summarized in the subsections below.

2.9.1 Insects

 **Carpenter Bee**	 **Bumble Bee**	 **Yellow Jacket**
 **Horse Fly**		

Environment	Nests/hives are found in brush, grasses, and on the ground (especially for wasps). Habitat is more likely in wooded areas.
Health Hazards	Stinging of site personnel (bees and yellow jacket) and biting of site personnel (horse flies). Swelling and discomfort are typical; however, some people (rare) are hypersensitive to the injected toxins.
Symptoms	Swelling, itching, and minor pain are typical symptoms. Persons hypersensitive to the injected toxins may experience anaphylactic shock (violent and immediate response: intense swelling of body, life-threatening, potentially fatal).
Treatment	Refer to First Aid Procedures below.
Protective Measures	***Awareness*****:** Note the presence of habitat or potential habitat and demarcate as appropriate (SSHO will apply paint/tape/other to mark the location; employees will stay clear of the habitat). ***PPE*****:** Level D PPE is required. Personnel will spray exposed skin with insect repellant containing DEET (approximately 33 percent solution) and clothing with insect repellant containing permethrin/permanone or DEET. ***Note*****:** Personnel with hypersensitivity to stings are required to carry an antidote pen on their person, instruct personnel on the use and location of the pen, and notify the SSHO. If stung, personnel must notify the SSHO immediately.
First Aid Procedures	General first aid procedures in the event of a sting include washing the area with soap and water, removing the stinger (if present), applying a cold compress, and applying a topical antihistamine. In the event of excessive swelling (greater than 10 centimeters), swelling of the lips/throat, faintness, dizziness, confusion, rapid heartbeats, hives, or nausea/cramps/vomiting occurs notify the SSHO and seek professional medical treatment. An antidote pen will be applied to address anaphylactic shock.
Inoculation	Not applicable.

2.9.2 Arachnids (Spiders)

Black Widow Spider

Environment/ Habitat	The Black Widow typically weave disorderly webs; however, they leave their webs to hunt and are typically found in woodpiles. At night, these spiders may seek warmth in work gloves, boots, or previously worn clothing.
Health Hazards	The toxicity of the venom is inversely proportional to size. The venom of the black widow may be potent and can develop localized infection; however, systemic symptoms are more frequent (listed below).
Symptoms	Symptoms of spider bites from the widow species include low severity symptoms (swelling, itching, and minor pain), systemic response (nausea, vomiting, fever, rashes, muscle and joint pain), and localized severe symptoms (necrotizing ulcers, severe swelling, and potential gangrene).
Treatment	Refer First Aid Procedures below.
Protective Measures	***Awareness:*** Typically, a bite from this spider is not noticed until several hours later when the symptoms above become noticeable or severe. Look for disorderly webs; shake out clothing, boots, and gloves prior to wearing; and minimize disturbance of potential habitat. ***PPE:*** Level D PPE is required. Personnel will spray exposed skin with insect repellant containing DEET (approximately 33 percent solution) and clothing with insect repellant containing permethrin/permanone or DEET. If bitten, personnel must notify the SSHO immediately.
First Aid Procedures	***Venomous Spider Bites:*** Wash the area with soap and water; apply a cold compress and elevate the area above the level of the heart; then seek professional medical treatment. DO NOT apply heat or steroid creams, remove venom by suction, apply electricity, or apply a tourniquet.
Inoculation	Not Applicable.

2.9.3 Ticks

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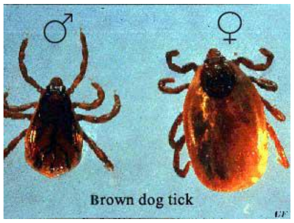
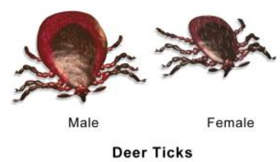
<tr><td>
</td><td></td><td>
</td><td></td></tr>
<tr><td>Brown Dog Tick</td><td>Wood Tick</td><td>Deer Tick</td><td>Lone Star Tick</td></tr>
<tr><td>Environment</td><td colspan="3">Ticks are typically found along well-defined paths of grassy or transitional vegetation waiting for hosts to pass. Ticks cannot fly or jump and wait on leaves or long grasses in a position called questing—holding two pairs of legs outstretched while two pairs of legs maintain a connection on the vegetation. Ticks detect breath, body odors, body heat, moisture changes, and vibrations and may seek attachment locations with thin skin (e.g., ears) or elevated body heat (e.g., underarms, groin, and armpits). Abundant habitat for ticks is present within undergrowth and becomes more limited within fully established forests. Ticks are most active between March and October.</td></tr>
<tr><td>Health Hazards</td><td colspan="3">Transmission of Lyme Disease, Rocky Mountain Spotted Fever, Tularemia, Babesiosis, Ehrlichiosis, and Southern Tick Associated Rash Illness. These illnesses are caused by either a parasite or a bacterium transmitted by the tick. Secondary infection due to bite and/or leaving mouthparts in epidermis.</td></tr>
<tr><td>Symptoms</td><td colspan="3">A bite area may be tender and mildly swollen. Symptoms of the tick-borne illnesses listed above may include a rash, headaches, swelling, and potentially worsening symptoms including nausea, vomiting, abdominal pain, muscle pain, lack of appetite, and upper respiratory symptoms. A rash may occur; however, it does not occur in every case. Therefore, the absence of a rash does not indicate absence of infection. Monitor the bite location for signs of infection (possible but unlikely) including increased swelling and/or a localized fever.</td></tr>
<tr><td>Treatment</td><td colspan="3">Refer to First Aid Procedures below for acute actions. Treatment is required by medical professionals and typically includes a complete dose of an antibiotic.</td></tr>
<tr><td>Protective Measures</td><td colspan="3">Awareness: Wear light-colored clothing and perform tick checks in the morning, in the evening, after bathing, and intermittently throughout the day. During work hours, have other site personnel inspect clothing for the presence of ticks.

PPE: Level D PPE is required. Personnel will spray exposed skin with insect repellant containing DEET (approximately 33 percent solution) and clothing with insect repellant containing permethrin/permanone or DEET. Tuck and tape for ticks: tuck trouser legs into boots and tape boots to trouser legs. Also, tuck shirts into pants and wear a belt.</td></tr>
<tr><td>First Aid Procedures</td><td colspan="3">If the tick is embedded, remove the tick using tweezers to grasp the tick at the mouthparts and pull straight out (do not twist/jerk as the mouthparts may separate from the tick and increase the risk of infection). Clean the bite area with soap and water, alcohol (free phase or within hand sanitizers), and apply antibiotic ointment beneath a bandage. Monitor yourself and other site personnel for symptoms described above. Report all tick bites, suspected tick bites, and/or potential symptoms of tick-borne illness to the SSHO immediately and less than 24 hours from the incident.</td></tr>
<tr><td>Inoculation</td><td colspan="3">Currently, there is no vaccine available for the illnesses listed above.</td></tr>
</table>

2.9.4 Poisonous Snakes

		
Eastern Massasauga	**Timber Rattlesnake**	**Copperhead Snake**

Environment	Snakes are found sunning themselves on rocks and boulders, logs, roads, and/or open areas and are typically found wherever small rodents are present as a food source.
Health Hazards	***Bites*****:** Physical injury and deleterious response to snake venom including severe pain. The Copperhead is responsible for the most bites; however, the venom is not generally fatal. Mortality is linked to availability of medical attention, not venom toxicity.
Symptoms	***Physical Injury*****:** Pair of puncture marks, redness and swelling, and severe pain. ***Venom Response*****:** Nausea and vomiting, labored breathing, disturbed vision, increased salivation and sweating, and localized numbness or tingling of face and/or limbs.
Treatment	Refer to First Aid Procedures below, seek professional medical attention.
Protective Measures	***Awareness*****:** Snakes avoid confrontation whenever possible. Look for snakes and habitat when walking within the work areas. ***PPE*****:** Level D PPE is required. The small fangs of the Copperhead are unlikely to penetrate work trousers. Snake chaps are required in overgrown areas.
First Aid Procedures	Following any snake bite, attempt to note the color and shape of the snake and seek professional medical attention immediately. Keep very still and very calm and sit with the bite location *below* heart level; wash the bite with soap and water; clean the area with alcohol; cover the bite with antibiotic ointment and a clean, dry, dressing. **DO NOT:** handle/capture the snake; wait for symptoms to appear; apply a tourniquet; lance the wound; apply suction; immerse in water; ingest alcohol or caffeine.
Inoculation	Not applicable.

2.9.5 Poisonous Plants

A survey of poisonous plants in the region indicated the presence of Poison Ivy and Poison Oak.

	 **Poison Ivy (Shrub)**	 **Poison Oak**
Environment	The plants listed above are all regionally found on Iona Island.	
Health Hazards	***Poison Ivy (Urushiol Oil)**:* Poison Ivy secretes urushiol oil, which causes contact dermatitis that can become severe if introduced into mucous membranes (i.e., eyes, nose).	
Symptoms	Swelling and itching; red rash within a few days of contact; bumps, streaking, and weeping blisters (blisters fluids not contagious). The rare potential exists for a severe allergic reaction including severe swelling or difficulty breathing.	
Treatment	Refer to First Aid Procedures below.	
Protective Measures	***Awareness***: Identify and avoid the plants listed above. Attempt to access the sampling locations using another route, or slightly relocate sampling locations, if the plants are present in the work area. Notify the SSHO if/when these plants are observed. ***Prevention:*** Clean tools used near known or suspected Poison Ivy with soap/water. ***PPE***: Modified Level D PPE is required.	
First Aid Procedures	***Urushiol Oil***: Immediately rinse skin and wash with soap and water; apply a cold compress and hydrocortisone cream (do not apply to open blisters); and seek professional medical attention if severe swelling or difficulty breathing is observed. Generally, an oral antihistamine (e.g., diphenhydramine) may be taken to reduce the allergic response.	
Inoculation	Not applicable.	

2.9.6 Harmful Animals

No harmful animals harboring fleas or disease are anticipated to be near the zones of work. If wild animals are encountered, retreat to the support vehicle, and notify the SSHO immediately.

2.9.7 Plants Causing Skin and Tissue Injury

Contact with sharp leaves, nettles, and thorns are of special concern to site personnel. This concern stems from the fact that punctures, cuts, and even minor scrapes caused by accidental contact may result in non-infectious skin lesions, and the introduction of fungi or bacteria through the skin or eye. This is especially important because the warm moist environment created inside protective clothing is ideal for the propagation of fungal and bacterial infection. Personnel receiving any of the injuries listed above, even minor scrapes, will report it immediately to the SSHO for initial and continued observation and care of the injury. Keeping the skin covered as much as possible (i.e., long pants and long-sleeved shirts) in areas where these plants are known to exist will limit much of the potential exposure. If the rash is scratched, secondary infections can occur. Avoid contact with sharp leaves, thorns, and nettles; maintain proper hygiene; and wear Level D PPE.

2.10 MUNITIONS AND EXPLOSIVES OF CONCERN HAZARDS

MEC may be encountered at the site. All personnel should be alert for MEC. Avoidance procedures and techniques will be utilized on tasks not associated with the MEC investigation. Personnel performing tasks related to MEC investigation will follow the approved practices and procedures identified in the approved planning documents. Specific descriptions of potential MEC onsite are presented under separate cover in the Explosive Site Plan (ESP). A list of MEC-related tasks to be performed during this project is provided below:

- Unexploded Ordnance (UXO) escort of non-UXO qualified personnel (MEC avoidance)
- Surface clearance of land-based geophysical investigation areas
- Surface and subsurface MEC investigation
- Underwater MEC investigation
- Material potentially presenting an explosive hazard inspection and certification as material documented as safe prior to packaging for shipment
- Quality control inspection of completed field activities.

All project personnel will adhere to safe work procedures when working in an area with potential MEC. The following general precautions with regard to MEC will be observed at all times:

- DO NOT touch or move any ordnance item(s) regardless of the markings or apparent condition unless qualified to do so.
- DO NOT visit an ordnance site if an electrical storm is occurring or approaching. If a storm approaches during a site visit, leave the site immediately and seek shelter.
- DO NOT use radios or cellular phones in the vicinity of suspect ordnance items.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, lighters, or other flame-producing devices onto a munitions response site.

- DO NOT rely on color code for positive identification of ordnance item(s) nor their contents.

- Approach ordnance items from the side; avoid approaching the front or rear areas.

- Always assume ordnance items contain a live charge until it can be ascertained otherwise by a qualified individual.

2.10.1 Specific Actions to be taken upon Locating MPPEH

Do not be misled by markings on the ordnance item stating practice or inert. Even practice items may have explosive charges that are used to mark/spot the point of impact; or the item could be incorrectly marked.

- Follow Engineer Manual 385-1-97 Safety Precautions (USACE 2014) for the type of munitions or MEC encountered.

- Do not roll the item over or scrape the item to identify the markings.

- The location of any ordnance items found during sweep activities should be clearly marked so they can be easily located and avoided. Follow the procedures set forth in the MEC Quality Assurance Project Plan.

- Upon locating any munitions potentially presenting an explosive hazard (MPPEH), notify the Unexploded Ordnance Safety Officer (UXOSO) and/or the SSHO so appropriate measures can be taken.

2.11 BOAT OPERATIONS AND DIVING HAZARDS

Hazards associated with boat operations including notice to mariners are addressed in Appendix G (Marine Safety) of the APP and hazards associated with diving are addressed in Appendix H (Diving Safety Plan) of the APP.

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Table 2-1 Site-Specific Hazard Evaluation for Land Based Activities

Potential Hazards[a]	Controls or training being utilized[b]	Applicable AHAs (to be completed) [c]	Activities											
			Mobilization and Demobilization	Land Survey	Detector-Aided Surface Clearance	Land-Based Geophysical Survey	Brush Clearing	Intrusive Investigation Mag and Dig	Intrusive Investigation Target of Interest Investigation	Direct Push Technology Soil Boring	Bedrock Well Installation	Groundwater Sampling	Soil Sampling	Sediment Sampling
Chemical Hazards														
MCs to include explosives and potentially lead (source – breached MEC items)	Site control by the Senior Unexploded Ordnance Supervisor (SUXOS), Level D PPE, Site-specific awareness training	General, Intrusive Investigation, Anomaly Avoidance, MPPEH Inspection, Well Installation, Direct-push Soil Boring, Groundwater Sampling, Soil Sampling, and Sediment Sampling						X	X	X	X	X	X	X
Chemical constituents of concern (includes metals, SVOC, and VOC; source – historical operations)	Level D PPE, Site-specific awareness training	General, Intrusive Investigation, Direct-push Soil Boring, Well Installation, Ground-water Sampling, Soil Sampling, and Sediment Sampling								X	X	X	X	X
Fuels (source – onsite vehicles and equipment)	Level D PPE, site-specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Physical Hazards														
General Hazards	Level D PPE, site-specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
MEC	Site control by the SUXOS, Level D PPE, site-specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Fire/Explosion	Site control by the SUXOS or SSHO, Site-specific awareness training	MPPEH Inspection, Direct-push Soil Boring, Well Installation	X				X	X	X	X	X			
Heavy Equipment (Mini Excavator and drill rigs)	Operator with training and experience, Site specific awareness training	Intrusive Investigation, Direct-push Soil Boring, Well Installation						X	X	X	X			
Utilities	Site specific awareness training	Intrusive Investigation, Direct Push Soil Boring, Well Installation						X	X	X	X			
Hand and Power Tools	Site specific awareness training	Large Hand Tools	X				X							
Weather Hazards	Site specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Material Handling and Moving	Site specific awareness training	General, Intrusive Investigation, MPPEH Inspection, Direct-push Soil Boring, Well Installation	X					X	X	X	X	X		
Heat Stress	Site specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Cold Stress	Site specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Water Hazards	Site specific awareness training	Boating and Diving							X					
Cumulative Trauma Disorder	Task-specific awareness training	General	X	X	X	X	X	X	X	X	X	X	X	X
Biological Hazards														
Insects, Ticks, and Spiders	Site specific awareness training, insect repellent, Level D PPE	General	X	X	X	X	X	X	X	X	X	X	X	X
Poisonous Snakes	Site specific awareness training, insect repellent, Level D PPE	General	X	X	X	X	X	X	X	X	X	X	X	X
Wild Animals	Site specific awareness training, insect repellent, Level D PPE	General	X	X	X	X	X	X	X	X	X	X	X	X
Poisonous Plants	Site specific awareness training, Level D PPE	General	X	X	X	X	X	X	X	X	X	X	X	X

[a] Each hazard is evaluated in Section 2 of the SSHP. Required training is detailed in Section 6 of the APP. Site-specific activity hazard analyses for each task, including appropriate controls, are presented in Appendix A of the APP.
NOTES:
MPPEH = Material potentially presenting an explosive hazard.

An American Board of Industrial Hygiene (ABIH) - Certified Industrial Hygienist (CIH) and a Certified Safety Professional (CSP) has performed the above evaluation:

5 December 2018

Name: Peter Garger, CIH (ABIH No. 3118) Date
CSP (Board of Certified Safety Professionals No. 20560) Title: Director of Safety and Health/Safety and Health Manager (SHM)

Table 2-2 Site-Specific Hazard Evaluation for Water-Based Activities

Potential Hazards[a]	Controls or training being utilized[b]	Applicable AHAs (to be completed)[c]	Activities: Mobilization/ Demobilization	Activities: Diving Magnetometer Survey	Activities: Intrusive Marine Investigation
Chemical Hazards					
Munitions Constituents to include explosives and potentially lead (source – breached MEC items)	Site control by the SUXOS, Level D PPE, Site-specific awareness training	General, Intrusive Investigation, MEC Avoidance, MPPEH Inspection, Soil Sampling			X
Fuels (source – onsite vehicles and equipment)	Level D PPE, Site-specific awareness training	General, Intrusive Investigation	X	X	X
Physical Hazards					
General hazards	Level D PPE, site specific awareness training	General	X	X	X
Munitions and explosives of concern (MEC)	Site control by the SUXOS, Level D PPE, site specific awareness training	General	X	X	X
Fire/Explosion	Site control by the SUXOS or SSHO Site-specific awareness training	General, MPPEH Inspection, MEC Disposal		X	X
Hand and Power Tools	Site-specific awareness training	Large Hand Tools Use	X		
Weather Hazards	Site-specific awareness training	General	X	X	X
Material Handling and Moving	Site-specific awareness training	General, Intrusive Investigation, Diving, Boating Operations	X	X	X
Boat Capsizing/Sinking	Operator with training and experience, site specific awareness training	Boating Operations	X	X	X
Drowning	Operator with training and experience, Certified Diver , site specific awareness training	Boating Operations and Diving	X	X	X
Man Overboard	Operator with training and experience, Certified Diver, site specific awareness training	Boating Operations and Diving	X	X	X
Struck by hazards	Operator with training and experience, Certified Diver, site specific awareness training	Boating Operations and Diving	X	X	X
Decompression Sickness	Certified Diver, site specific awareness training	Diving		X	X
Heat Stress	Site-specific awareness training	General	X	X	X
Cold Stress	Site-specific awareness training	General	X	X	X
Cumulative Trauma Disorder	Task-specific awareness training	General	X	X	X
Biological Hazards					
Insects, ticks, and spiders in marsh	Site-specific awareness training, insect repellent, Level D PPE	General	X		

NOTES:
(a) Each hazard will be evaluated in Section 2 of the Site Safety and Health Plan (SSHP) of the Accident Prevention Plan (APP). Required training will be detailed in Section 6 of the APP.
(b) The required site specific training will be conducted prior to site mobilization and during site mobilization as required. The SSHO and/or UXOSO, as applicable will brief all visitors to the site on the site hazards and controls as they pertain to the site and activities being conducted. All visitors will be required to sign a visitor log and will be escorted at all times by the field manager, SSHO, SUXOS, or UXOSO/UXOQCS as appropriate depending on the ongoing activity. Training includes Safety and Occupational Health Training (29 CFR 1910.120 (e)-compliant 40-Hour HAZWOPER) for all field personnel performing tasks noted above unless noted otherwise and MEC-Awareness training by UXOSO. Additionally, operators with training and experience will be used for equipment operation and boating. Where appropriate, training will be documented through certificates (i.e. 40-hour OSHA training, etc.) that will be presented in Attachment C of the APP.
(c) Site-specific AHA for each task will be developed and used by the field crews/workers performing the work, with the assistance of others (SSHO, UXOSO, Quality Control, Superintendent, etc.) as needed. The initial, accepted AHAs will be provided to and used by the field crews/workers that are performing the activities. AHAs are considered living documents and they are intended to be updated by the workers as needed in the field.

An American Board of Industrial Hygiene (ABIH) - Certified Industrial Hygienist (CIH) and a Certified Safety Professional (CSP) has performed the above evaluation:

20 November 2018

Name: Peter Garger, CIH (ABIH No. 3118) Date
CSP (Board of Certified Safety Professionals No. 20560) Title: Director of Safety and Health/Safety and Health Manager (SHM)

Table 2-3 Potential Site Chemical Hazards

Compound	Probably Effects Level or Threshold Limit Value/Short-Term Exposure Limit	Immediately Dangerous to Life or Health	Route of Exposure	Symptoms
Volatile Organic Compound				
Acetone	500 ppm	2,500 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, nose, throat; headache, dizziness, central nervous system (CNS) depressant, dermatitis.
Bromoform *Skin*	0.5 ppm	850 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, respiratory system; CNS depressant; liver, kidney damage.
Bromomethane (Methyl bromide) *Skin*	1 ppm	Ca 250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, respiratory system; muscular weakness, incoherence, visual disturbance, vertigo; nausea, vomiting, headache; malaise; hand tremor; convulsions; dyspnea; skin vesiculation. Liquid: frostbite; carcinogen.
2-Butanone (MEK)	200 ppm/300 ppm	3,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin, nose; headache, dizziness; vomiting; dermatitis.
Carbon disulfide *Skin*	1 ppm	500 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Dizziness, headache, poor sleep, fatigue, nervousness, anorexia, low-weight; psychosis; polyneuritis; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney, liver injury; eye, skin burns; dermatitis; reproductive effects.
Carbon tetrachloride *Skin*	5 ppm/10 ppm	Ca 200 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin; CNS depressant; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoherence; carcinogen.
Chlorobenzene	10 ppm	1,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin, nose; drowsiness, incoherence, CNS depressant.
Chloroethane (Ethyl chloride) *Skin*	100 ppm	3,800 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Incoherence, inebriation; abdominal cramps; cardiac arrhythmia, cardiac arrest; liver, kidney damage.
Chloroform	10 ppm C 50 ppm	Ca 500 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin; dizziness, mental dullness, nausea, confusion; headache, fatigue, anesthesia; enlarged liver; carcinogen.
Chloromethane (Methyl chloride) *Skin*	50 ppm/100 ppm C 200 ppm	Ca 2,000 ppm	Inhalation, Skin/Eye Contact	Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; Liquid: frostbite; reproductive, teratogenic effects; carcinogen.
1,1-Dichloroethane (1,1-DCA)	100 ppm	3,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated skin; CNS depressant; liver, kidney, lung damage.
1,1-Dichloroethylene (1,1-DCE) (Vinylidene chloride)	5 ppm	Ca	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, throat; dizziness, headache, nausea; liver and kidney dysfunction.
1,2-Dichloroethylene	200 ppm	1,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, respiratory system; CNS depressant.
1,3-Dichloropropene (cis- and trans-)	1 ppm	Ca	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin, upper respiratory system; eye, skin burns; lassitude, loss of appetite, diarrhea, vomiting, slowing of pulse; CNS depressant.
Diesel Fuel (total hydrocarbons) *Skin*	100 mg/m^3 (approximately 15 ppm)	—	Inhalation, Ingestion, Skin/Eye Contact	Dermatitis.
Ethanol	1000 ppm	3300 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects
Ethylene dichloride (1,2-Dichloroethane)	10 ppm	Ca 50 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, corneal opacity; CNS depressant; nausea, vomiting; dermatitis; liver, kidney, CNS damage; carcinogen.
Formaldehyde	C 0.3 ppm	Ca 20 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritation eyes, nose, throat, respiratory system; lacrimation (discharge of tears); cough; wheezing; [potential occupational carcinogen]
Gasoline	300 ppm/500 ppm	Ca	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid); possible liver, kidney damage; [potential occupational carcinogen]
2-Hexanone (MBK) *Skin*	5 ppm/10 ppm	1,600 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose; peritoneal neuritis; weakness, paresthesis; dermatitis; headache; drowsiness.
Kerosene/Jet Fuels (as total hydrocarbon vapor) *Skin*	200 mg/m^3 (approximately 35 ppm)	—	Inhalation, Ingestion, Skin/Eye Contact	Skin irritant; CNS impairment; upper respiratory irritant.

Compound	Probably Effects Level or Threshold Limit Value/Short-Term Exposure Limit	Immediately Dangerous to Life or Health	Route of Exposure	Symptoms
Methanol *Skin*	200 ppm / 250 ppm STEL	25,000 ppm	Inhalation, Ingestion, Skin Contact, Absorption	Irritated eyes (watering, inflamed lids, painful sensitization to light), nose irritation, headache, fatigue, nausea, visual impairment. Gastrointestinal irritation, possible kidney impairment. Feeling of coldness, dryness, cracking leading to dermatitis; headache, fatigue, visual disturbances.
Methane	1,000 ppm	1.5 %	Inhalation	CNS impairment; cardiac sensitization; at 1.5% creates oxygen depletion.
4-Methyl-2-pentanone (MIBK)	20 ppm/75 ppm	500 ppm	Inhalation, Ingestion, Skin/Eye Contact	Upper respiratory tract irritant; irritated eyes, skin, mucous membranes; dizziness; headache, narcosis, coma; dermatitis.
Methylene chloride (Dichloromethane)	25 ppm/125 ppm 12.5 AL	Ca 2,300 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin; fatigue, weakness, sleepiness, light-headedness, nausea.
Methyl tert-butyl ether (MTBE)	50 ppm	—	Inhalation, Ingestion, Skin/Eye Contact	Upper respiratory tract irritant; kidney damage.
Styrene	20 ppm/40 ppm C 200 ppm	700 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose; respiratory system; headache, fatigue, dizziness, confusion, malaise, drowsiness, weakness, unsteady gait; narcosis; defatting dermatitis; possible liver injury, reproductive effects.
1,1,2,2-Tetrachloroethane (1,1,2,2-TECA) *Skin*	1 ppm	100 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; kidney damage; carcinogen.
Tetrachloroethylene (PCE) (Perchloroethylene)	25 ppm/100 ppm C 200 ppm	Ca 150 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose, throat; nausea, flush face, dizziness, headache, liver damage.
1,1,1-Trichloroethane (TCA) (Methyl chloroform)	350 ppm/450 ppm	700 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin; headache, lassitude, CNS depressant, poor equilibrium; dermatitis; cardiac arrhythmia; liver damage.
1,1,2-Trichloroethane (1,1,2-TCA) *Skin*	10 ppm	Ca 100 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose; CNS depressant; liver, kidney damage, dermatitis; carcinogen.
Trichloroethylene (TCE)	10 ppm/25 ppm C 200 ppm	Ca 1,000 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin; headache, dizziness, vertigo, visual distortion, fatigue, giddiness, vomiting, dermatitis, nausea.
Vinyl chloride	1 ppm/C 5 ppm 0.5 ppm AL	Ca	Inhalation, Skin/Eye Contact (with liquid)	Weakness, abdominal pain, GI bleeding, enlarged liver.
Semi-Volatile Organic Compound				
Benzidine *Skin*	— (exposures by all routes should be as low as possible)	Ca	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Hematosis, secondary anemia from hemolysis, acute cystitis, acute liver disorders, dermatitis; painful, irregular urination; bladder cancer.
Di-n-butyl-phthalate	5 mg/m^3	4,000 mg/m^3	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, upper respiratory system, and stomach.
1,2-Dichlorobenzene (o-DCB)	25 ppm/50 ppm	200 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose; liver and kidney damage, skin blisters.
1,4-Dichlorobenzene (p-DCB)	10 ppm	Ca 150 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Headache, eye irritation, profuse rhinitis, weight loss, nausea, vomiting.
3-3' Dichlorobenzidine	— (exposures by all routes should be as low as possible)	Ca	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Skin sensitivity, dermatitis; headache, dizziness; caustic burns; frequent urination; dysuria; hematosis; GI upset; upper respiratory infection; carcinogen.
Diethyl phthalate	5 mg/m^3	None	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, skin, nose, throat; headache, dizziness, nausea; lacrimitis; possible polyneuritis, vestibular dysfunction; pain, numbness, weakness, spasms in arms and legs.
Dimethyl phthalate	5 mg/m^3	2,000 mg/m^3	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, upper respiratory system; stomach pain.
Hexachlorobutadiene *Skin*	0.02 ppm	Ca	Inhalation, Ingestion, Absorption, Skin/Eye Contact	In animals: irritated eyes, skin, respiratory system; kidney damage; carcinogen.

Compound	Probably Effects Level or Threshold Limit Value/Short-Term Exposure Limit	Immediately Dangerous to Life or Health	Route of Exposure	Symptoms
Hexachlorocyclopentadiene	0.01 ppm	None	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, respiratory system; eye, skin burns; lacrimitis; sneezing, coughing, dyspnea, salivating, pulmonary edema; nausea, vomiting, diarrhea.
Hexachloroethane *Skin*	1 ppm	Ca 300 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, mucous membranes; carcinogen.
Isophorone	C 5 ppm	200 ppm	Inhalation, Ingestion, Skin/Eye Contact	Irritated eyes, nose, throat; headache, nausea, dizziness, fatigue dermatitis, narcosis.
2-Methyl phenol (o-Cresol) *Skin*	5 ppm	250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, mucous membranes; CNS effects: confusion, depression, respiratory failure; dyspnea, irregular rapid respiration, weak pulse; eye, skin burns; dermatitis; lung, liver, kidney, pancreas damage.
3-Methyl phenol (m-Cresol) *Skin*	5 ppm	250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, mucous membranes; CNS effects: confusion, depression, respiratory failure; dyspnea, irregular rapid respiration, weak pulse; eye, skin burns; dermatitis; lung, liver, kidney, pancreas damage.
4-Methyl phenol (p-Cresol) *Skin*	5 ppm	250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, mucous membranes; CNS effects: confusion, depression, respiratory failure; dyspnea, irregular rapid respiration, weak pulse; eye, skin burns; dermatitis; lung, liver, kidney, pancreas damage.
4-Nitroaniline (p-Nitroanaline) *Skin*	3 mg/m^3	300 mg/m^3	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated nose, throat; cyanosis, ataxia; tachycardia, tachypnea; dyspnea; irritability; vomiting, diarrhea; convulsions; respiratory arrest; anemia; methemoglobinemia; jaundice.
N-Nitrosodimethylamine *Skin*	— (exposures by all routes should be as low as possible)	Ca	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Nausea, vomiting, diarrhea, abdominal cramps; headache; fever; enlarged liver, jaundice; decreased liver, kidney, pulmonary function; carcinogen.
Pentachlorophenol (PCP) *Skin*	0.5 mg/m^3	2.5 mg/m^3	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose, throat; sneezing, coughing; weakness, anorexia, low-weight; sweating; headache, dizziness; nausea, vomiting; dyspnea; chest pain; high fever; dermatitis.
Phenol *Skin*	5 ppm	250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, nose, throat; weight loss, dark urine, liver and kidney damage, muscle ache, skin burns, dermatitis, tremors, convulsions.
1,2,4-Trichlorobenzene	C 5 ppm	—	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Irritated eyes, skin, mucous membrane; liver/kidney damage, possible teratogenic effects.
Semi-volatile Organic Compounds (PAH)				
Benzo[a]anthracene	0.2 mg/m^3 [a]	80 mg/m^3 [a] Ca	Inhalation, Skin/Eye Contact	Dermatitis, bronchitis; suspected human carcinogen.
Benzo[a]pyrene	0.2 mg/m^3 [a]	80 mg/m^3 [a] Ca	Inhalation, Skin/Eye Contact	Dermatitis, bronchitis; suspected human carcinogen.
Benzo[b]fluoranthene	0.2 mg/m^3 [a]	80 mg/m^3 [a] Ca	Inhalation, Skin/Eye Contact	Dermatitis, bronchitis; suspected human carcinogen.
Chrysene	0.2 mg/m^3 [a]	80 mg/m^3 [a] Ca	Inhalation, Skin/Eye Contact	Dermatitis, bronchitis; suspected human carcinogen.
Naphthalene	10 ppm/15 ppm	250 ppm	Inhalation, Ingestion, Absorption, Skin/Eye Contact	Eye irritation, headache, confusion, vomiting, profuse sweating, abdominal pain.
Metals				
Antimony (Sb)	0.5 mg/m^3	50 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Irritated eyes, skin, nose, throat, mouth; coughing, dizziness, headache, nausea, vomiting, diarrhea, stomach cramps, insomnia, loss of smell.
Arsenic (inorganic compounds as As)	0.01 mg/m^3 0.005 mg/m^3 AL	Ca 5 mg/m^3 (as As)	Inhalation and Ingestion via particulates, Skin/Eye Contact	Ulceration of nasal septum, dermatitis, gastrointestinal bleeding.
Barium (and soluble compounds as Ba)	0.5 mg/m^3	50 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Upper respiratory irritation, muscle spasm, slow pulse, irritated eyes, skin.
Beryllium (and compounds as Be)	0.00005 mg/m^3 C 0.005 mg/m^3	Ca 4 mg/m^3	Inhalation via particulates, Skin/Eye Contact	Berylliosis (chronic exposure): anorexia, low-weight; weakness, chest pain; cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritated eyes; dermatitis; carcinogen.

Compound	Probably Effects Level or Threshold Limit Value/Short-Term Exposure Limit	Immediately Dangerous to Life or Health	Route of Exposure	Symptoms
Cadmium (Cd)	0.005 mg/m^3 0.0025 mg/m^3 AL	Ca 9 mg/m^3	Inhalation and Ingestion via particulates	Pulmonary edema, dyspnea, cough, chest tight, subs pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; loss of smell; emphysema, proteinuria, mild anemia; carcinogen.
Chromium (Cr), Metal, II, and III compounds	0.5 mg/m^3	250 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Histologic fibrosis of lungs; irritated eyes and skin.
Chromium (Cr)VI compounds as CrO_3	0.005 mg/m^3 0.0025 mg/m^3 AL	Ca 15 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Irritation respiratory system; nasal septum perforation; liver, kidney damage; leukocytosis (increased blood leukocytes), leukopenia (reduced blood leukocytes), eosinophilia; eye injury, conjunctivitis; skin ulcer, sensitization dermatitis; [potential occupational carcinogen]
Cobalt (and inorganic compounds as Co)	0.02 mg/m^3	20 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Irritation of nasal membranes, pharynx, nasal perforation, eye irritation.
Copper (Cu)	1 mg/m^3 0.1 mg/m^3 for fumes as Cu	100 mg/m^3	Inhalation via particulates, Skin/Eye Contact	Irritated eyes, upper respiratory system; metal fume fever: chills, muscular ache, nausea, fever, dry throat, cough, weakness, lassitude; metallic or sweet taste; discoloration of skin, hair.
Lead (and inorganic compounds as Pb)	0.050 mg/m^3 0.030 mg/m^3 AL	100 mg/m^3 (as Pb)	Inhalation and Ingestion via particulates, Skin/Eye Contact	Lassitude, insomnia, pallor, anoxia, weight loss, constipation, abdominal pain, colic, anemia, wrist paralysis.
Manganese (and inorganic compounds as Mn)	0.02 mg/m^3 C 5 mg/m^3	500 mg/m^3	Inhalation and Ingestion via particulates	Manganism; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea (breathing difficulty), rales, flu-like fever; low-back pain; vomiting; malaise (vague feeling of discomfort); lassitude (weakness, exhaustion); kidney damage; CNS function (neurobehavioral and neuropsychological changes).
Mercury (Hg) *Skin*	0.01/0.03 mg/m^3 alkyl compounds 0.025 mg/m^3 elemental and inorganic forms 0.1 mg/m^3 aryl compounds C 0.1 mg/m^3 elemental and inorganic forms	10 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Dizziness, nausea, vomiting, diarrhea, constipation, skin burns, emotional distance.
Nickel (Ni)	1.5 mg/m^3 elemental 0.1 mg/m^3 soluble inorganic compounds 0.2 mg/m^3 insoluble inorganic compounds	Ca 10 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Sensitive skin, asthma, nasal cavity irritation, pneumonitis, carcinogen.
Selenium (and compounds as Se)	0.2 mg/m^3	1 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Irritation eyes, skin, nose, and throat; headache, chills, dyspnea, bronchitis, metallic taste, garlic breath, liver/spleen damage.
Silver (metal dust and soluble compounds as Ag)	0.01 mg/m^3	10 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Blue-gray eyes, nasal septum, throat, skin; irritability, ulceration of skin; GI disturbance.
Thallium (and soluble compounds as Tl) *Skin*	0.02 mg/m^3 (I)	15 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact, Absorption	Nausea, diarrhea, abdominal pain, vomiting, peripheral neuropathy, tremor, chest pain, pulmonary edema.
Vanadium pentoxide (dust or fume as V_2O_5)	C 0.05 mg/m^3 respirable fraction	35 mg/m^3	Inhalation and Ingestion via particulates, Skin/Eye Contact	Irritated eyes, skin, throat; green tongue, metallic taste, eczema, cough, wheezing, bronchitis.
Acids / Corrosives				
Hydrochloric acid (as hydrogen chloride gas)	C 2 ppm	50 ppm	Inhalation, Absorption, Skin/Eye Contact	Irritation of skin, eyes, mucous membranes, esophagus, stomach; nausea, vomiting, intense thirst, diarrhea, erosion of exposed teeth
Nitric acid	2 ppm/4 ppm	25 ppm	Inhalation, Absorption, Skin/Eye Contact	Corrosive to body tissue. Dental erosion, irritation, corrosive burns of skin, eyes, upper respiratory tract, delayed pulmonary edema, pneumonitis, bronchitis.
Sulfuric acid	0.2 mg/m^3 thoracic fraction 1 mg/m^3	15 mg/m^3	Inhalation, Absorption, Skin/Eye Contact	Immediately damaging to any body tissue, it contacts at high concentrations. Severe or permanent damage to eyes, upper respiratory tract and lung damage.

Compound	Probably Effects Level or Threshold Limit Value/Short-Term Exposure Limit	Immediately Dangerous to Life or Health	Route of Exposure	Symptoms
Sodium Hydroxide	C 2 mg/m^3	10 mg/m^3	Inhalation, Ingestion, Skin/Eye Contact	Dissolves living tissue. Immediate burning to upper digestive tract, esophagus, stomach; painful swallowing; excessive salivation; excessive fluid surrounding lips, chin, tongue, coffee-ground like vomit, rapid/faint pulse, cold clammy skin, adhesion of lid to eyeball.
Other				
Portland Cement	1 mg/m^3 (E, R)	5000 mg/m^3	Inhalation, Ingestion, Skin and/or Eye Contact	Irritation eyes, skin, nose; cough, expectoration; exertional dyspnea (breathing difficulty), wheezing, chronic bronchitis; dermatitis.

(a) The PEL and IDLH are representative of coal tar pitch volatiles.
E = The value is for particulate matter containing no asbestos and < 1% crystalline silica.
I = Inhalable fraction
IDLH = Immediately Dangerous to Life and Health
IFV = Inhalable Fraction and Vapor
PAH = Polycyclic aromatic hydrocarbons
PEL = Permissible Exposure Limit
ppm = Parts per million
R = Respirable fraction
TLV = Threshold Limit Value
STEL = Short Term Exposure Limit (15 min)
AL = Action Level (OSHA)
C = Ceiling Limit
Ca = Carcinogen
CNS = Central Nervous System
GI = Gastrointestinal
N.D. = Not determined
Skin = Skin absorption can contribute to overall body dose
f/cc = Fibers per cubic centimeter of air.

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3. STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

Section 4 of the APP provides the organization, qualifications, and responsibilities of project staff. Appendix C of the APP presents resumes and/or certifications.

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4. TRAINING

This information is presented in Section 6 of the APP.

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5. PERSONAL PROTECTIVE EQUIPMENT

Based on the hazard assessment conducted by the SHM, and for tasks where engineering controls cannot eliminate the occupational hazards at the Iona Island FUDS, PPE is required. Employees have received Occupational Safety and Health Administration (OSHA) compliant PPE training as part of Hazardous Waste Operations and Emergency Response training.

5.1 SELECTION

The selection of the appropriate PPE was performed by the SHM. The type of PPE and level of protection will be reevaluated periodically[1] by the SSHO, with feedback from site workers, in light of any new information about the site or site operations. Selection of the protective ensembles described below conforms to the levels of protection as described in the National Institute for Occupational Safety and Health Publication 85–115. Selection is based on an evaluation of the performance characteristics of the PPE relative to the site requirements/ limitations, task-specific condition and duration, and hazards and potential hazards identified at the site.

5.2 PERSONAL PROTECTIVE EQUIPMENT USE

As stated above, EA will provide PPE and the proper training on its maintenance and use; however, the employees are required to use the PPE as provided and for the use of which it was intended.

5.3 TRAINING AND PROPER FITTING

Employees have received OSHA compliant PPE training as part of Hazardous Waste Operations and Emergency Response training. If the SSHO determines during site work that an employee needs to be re-trained, the SSHO will not allow the employee to perform the work activities until this re-training has occurred and will document the re-training as described in Table 6-1 of the APP.

5.4 INSPECTION AND IN-USE MONITORING

Inspection of PPE will be performed prior to use by the employee and is listed in Table 7-1 of the APP. PPE that does not pass inspection will be discarded and replaced.

5.5 MAINTENANCE AND STORAGE

Disposable PPE will be removed and disposed of in the contamination reduction zone. All PPE will be properly stored in site vehicles.

[1] As required, but typically associated with a set of changing conditions requiring evaluation of PPE changes.

5.6 LEVELS OF PROTECTION AND REQUIREMENTS

Levels of protection at the Iona Island FUDS include Level D, and Modified Level D. PPE required as part of first aid activities is not presented in this section; however, it will be provided for first aid/cardiopulmonary resuscitation (CPR) providers.

5.6.1 Level D Protection

Work tasks at the Iona Island FUDS contain no known atmospheric hazards and do not include splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals; therefore, Level D PPE includes:

- Work clothing consisting of long-sleeve shirts and work pants when working in heavily vegetated areas with potential for exposure to poisonous plants. Short sleeve shirts are acceptable when outside of heavily vegetated areas or when worn in conjunction with over-the-counter barrier creams. Coveralls are also acceptable at all times.

- Heavy-duty cloth or leather gloves, as necessary during brush cutting or other operations as identified in the AHAs (cut-resistant recommended). Not for work involving the handling of environmental samples.

- Steel-toe or composite boots (in accordance with American National Standards Institute [ANSI] Z41 and American Society for Testing and Materials International Standards F2412 and F2413).

- Hearing protection (earplugs or muffs) when in the exclusion zone within 25 ft of heavy equipment in operation

- Hard hats in accordance with ANSI/International Safety Equipment Association Z89.1; for operations with overhead hazards (drilling).

- High visibility apparel (e.g., blaze orange/yellow clothing and/or reflective safety vests) apparel is required when in the exclusion zone or when working near heavy equipment or traffic. It should be noted that that during hot work (e.g., welding), personnel either wear a flame-retardant safety vest or another employee (spotter) with a safety vest will be assigned to act as a lookout during the hot work.

- Safety glasses (Z87.1-rated) when cutting brush or otherwise exposed to flying debris.

- All disposable PPE will be bagged in plastic bags for non-hazardous disposal.

5.6.2 Modified Level D Protection

Modified Level D Protection includes Level D protection with the addition of nitrile gloves (when directly handling soil).

5.6.3 Level C Protection

Level C Protection is required only if environmental monitoring during drilling activities exceeds 5 ppm in the breathing zone and is not controllable by engineering controls and will include:

- Level D or Modified Level D requirements above.
- Respirators (See Respiratory Protection Plan in Section 9.9 of the APP).
- Protective face shields.

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6. MEDICAL SURVEILLANCE

Site personnel for work to be completed at the Iona Island FUDS will be required to be enrolled in the medical surveillance program with their employer. Site workers that anticipate being exposed to contaminants at the permissible exposure limit for 30 or more days a year or that may don respiratory protection will be enrolled in a medical surveillance program and will satisfactorily complete a comprehensive medical examination by or under the supervision of a licensed physician knowledgeable in occupational medicine prior to the initiation of field work. EA employees and subcontractors involved in those activities that may contact contaminated media (specifically, sampling activities and addressing investigation-derived waste) will be in the medical surveillance program. Medical examinations will be provided according to the following schedule:

- Prior to fieldwork assignment
- At least annually for employees covered by the program (biennially for those employees that do limited site work, with the approval of the occupational physician)
- At termination of employment or reassignment to an area where the employee had not been examined within the past 6 months
- As soon as possible after the development of signs or symptoms that may indicate an overexposure to hazardous substances or health hazards
- More frequently if the physician deems such examination necessary to maintain employee health.

Documentation for compliance with medical surveillance will be kept onsite[2]. Further documentation is maintained in EA's Office of Human Resources (410-584-7000). The records shall be complete and accurate and will be kept on file for at least 30 years after termination of employment. A minimum of the following information shall be kept:

- Name and social security number
- Physician's written opinions, recommendations, limitations, and test results
- Employee medical complaints related to hazardous waste operations
- Information provided to the physician by the employee concerning possible exposures, accidents, etc.

[2] This information is also initially presented in Attachment C of the APP.

6.1 FIRST AID AND MEDICAL TREATMENT

At least two onsite workers will be currently certified in both first aid and CPR by the American Red Cross or equivalent organization. Documentation of all personnel certifications will be kept onsite. EA has identified a hospital for emergency medical care for this project site. The hospital to be used during emergencies for this site is the New York Presbyterian Hudson Valley Hospital (914) 737-9000.

Employees will have the telephone number to the hospital during working hours should an occupational illness or injury occur. Individuals onsite currently certified in first aid will be called out at the start of each day's activities during the health and safety meeting. Certifications will be present onsite and will include separate Engineer Manual 385-1-1 03.A.06a-c-compliant bloodborne pathogen training. For information on this training, refer to Section 6 of the APP. A site-specific Bloodborne Pathogen Exposure Control Plan is contained in Section 9.6 of the APP.

6.2 MEDICAL RESTRICTION

Should an occupational injury or illness occur that restricts or limits an employee's ability to function at full capacity, EA maintains a policy of providing these employees with restricted or modified duty assignments whenever possible to allow them to continue to be productive.

6.3 MEDICAL RECORDS

Medical and personal exposure monitoring records will be maintained according to the requirements of 29 Code of Federal Regulations 1910.120 (f) and shall be kept for a minimum of 30 years beyond employment. Employee confidentiality shall be maintained.

7. EXPOSURE MONITORING

7.1 GENERAL

Exposure monitoring for temperature will be instituted during operations at the site. The monitoring program may be modified by the SHM with input from the UXOSO and or the SSHO, if site conditions and monitoring results warrant. Monitoring will be accomplished under the direction of the UXOSO and or the SSHO, who will interpret the results. Environmental monitoring requirements are presented on Table 7-1.

7.2 AIR MONITORING PROGRAM

The air monitoring program will include monitoring of personnel and work zones to assess levels of employee exposure, establish that the work zone designations are valid, and verify that the respiratory protection being worn by personnel (if required) is adequate during HTRW RI intrusive activities only (drilling) and MMRP RI intrusive activities (test pitting)/excavation. As specified in Table 7-1 (Environmental Monitoring Requirements, Action Levels, and Exposure Limits), air monitoring will be conducted during dust-generating tasks:

- Establish baseline concentrations and conduct negative exposure assessments
- Periodically during site operations.

Personnel properly trained in air monitoring procedures will perform necessary operation, calibration, and maintenance of air monitoring equipment.

7.2.1 General Area Monitoring

At a minimum, one general area monitor will be utilized during dust-generating, intrusive subsurface work, and noise-generating work activities to monitor airborne contaminants and noise; additional monitors may be utilized depending upon the configuration of the work area, number of workers, and/or type of work activity being conducted. General area monitoring will be conducted utilizing air samplers with flow rates sufficient to provide total sample volumes that will satisfy analytical instrument detection requirements.

7.2.2 Breathing Zone Monitoring

BZ monitoring will be conducted for VOCs using a photoionization detector as indicated on **Table 7-1**.

7.2.3 Real-Time Air Monitoring

Real-time monitoring of ambient dust levels will be conducted in work zones and other onsite areas to assess total dust concentrations during intrusive activities. Measurements will be collected at the anticipated source and in the breathing zone of site personnel during work operations.

7.2.4 Perimeter Monitoring

If general area or real-time air monitoring within work areas indicates readings above action levels, real-time monitoring for total dust concentrations and/or monitoring for airborne particulates will be conducted at the perimeter of the site during intrusive activities. If ambient dust levels exceed established action levels for a sustained period of time beyond the perimeter of the site, work will be stopped and the SHM and Project Manager will be notified. A decision will then be made as to how to proceed with the work and how to more fully characterize the airborne emissions. Work zones may need to be modified as a result of air monitoring readings during perimeter monitoring. If perimeter monitoring is warranted, the requirements presented in **Table 7-1** will be utilized.

7.3 CALIBRATION AND MAINTENANCE

Monitoring instruments will be calibrated initially and instructions in the manufacturers' operations manuals regarding calibration, cleaning, and maintenance of the instruments will be followed. A calibration and maintenance log for each instrument will also be maintained (Appendix D of the APP). The log should contain detailed descriptions of problems encountered with the instrument along with any records of factory calibration and repair.

Table 7-1 Environmental Monitoring Requirements, Action Levels, and Exposure Limits

Hazard	Instrument	Location/Type of Monitoring	Frequency	Action Level	Exposure Limit	Response
VOCs	Total Volatile Organics Detector (photoionization detector)	Breathing Zone during HTRW intrusive activities (drilling)	Every 30 minutes	Above background	5 ppm	Begin perimeter monitoring. Monitor continuously for total volatile organics. Begin contaminant specific monitoring for benzene (see below).
				>5 and <50 ppm		Upgrade to Level C. If total organic concentrations exceed 50 ppm, evacuate.
		Perimeter monitoring during HTRW intrusive activities (drilling)	2 times per day	Above background		Shut down operations and identify source of contamination and control by engineering controls.
Total Dust (Particulates not otherwise specified)	Real-time dust meter	Area Personal during intrusive activities (drilling and excavation)	Baseline and Periodic	5 mg/m^3	ACGIH = 10 mg/m^3 as "Particulates not otherwise specified" (inhalable particulates) PEL = 15 mg/m^3 (Nuisance dust)	If reading exceeds the Action Level, monitor continuously and notify SSHO. Implement engineering controls. If reading exceeds the Exposure Limit, stop work and notify SSHO.
Noise	Dosimeter	Area Personal during drilling	Baseline and Periodic	85 decibels 115 decibels	85-140 decibel	Hearing protection will be donned at 85 decibels Double hearing protection at levels above 115 decibels.
Temperature	Thermometer	Area	Baseline	Heat – Table 8-1 Cold – Table 8-3	Cold - 26°F	Heat – refer to Table 8-2 for work-rest regimen Cold – 26°F ensure no continuous skin exposure to cold (wear layers, gloves, etc.)

NOTES:
°F = Degrees Fahrenheit
ACGIH = American Conference of Governmental Industrial Hygienists
$PEL_{[Resp.\ fr.]}$ = Permissible Exposure Limit for respirable fraction of dust.

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8. HEAT AND COLD STRESS

It is the responsibility of the SSHO and each employee to ensure that temperature stress controls are adequate for the site conditions and tasks. All employees, and specifically the SSHO, are empowered and expected to stop or modify work and take any precautionary measures to prevent temperature related illnesses. Temperatures at the site range from an average low of 24°F to an average high of 47°F in January and an average low of 65°F to an average high of 92°F in July; therefore, all necessary precautions will be taken.

8.1 HEAT STRESS

Heat stress hazards can occur even in temperatures not commonly considered "hot" due to the level of physical activity, the level of PPE the worker is wearing, or the physical condition of the worker. Site training will include symptoms of heat-related illnesses and prevention techniques. Personnel will be familiar with the signs and symptoms of heat stress, including the following.

Heat Cramps—Muscle spasms in the abdomen or limbs. Frequent rest periods and fluid intake are appropriate measures to prevent or reduce heat cramps.

Heat Exhaustion—Severe dehydration; pale, clammy skin; profuse sweating; dizziness, light-headedness; slurred speech; rapid pulse; confusion; fainting; fatigue; cool skin; nausea. Affected personnel will be escorted from the site, set in a cool, shaded area, and given fluids slowly.

Heat Stroke—Life-threatening condition occurring when the body's temperature-regulating system improperly functions. Heat stroke is characterized by hot dry skin; rapid, deep breathing; lack of perspiration; delirium; high fever (often 106°F or more); nausea; and unconsciousness. Brain damage and/or death may occur if body temperature is not reduced. Provide fluids, use cooling devices (hose-down or shower), call emergency medical services or transport to hospital immediately.

Heat stress prevention techniques include:

- Resting frequently in a shaded or air-conditioned area.
- Allowing workers who are not acclimatized to take additional breaks.
- Drink at least 8 ounces of water or diluted Gatorade every 15–20 minutes.
- Monitoring workers on a periodic basis as described below.

Heat stress monitoring will be conducted in a manner that anticipates and prevents the onset of heat stress symptoms (i.e., work-rest regimens). The radial pulse of each worker will be counted by the SSHO during a 30-second period as early as possible during the rest period immediately following work activities. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle will be shortened by one-third and the rest period will be maintained. If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle will be shortened by another one-third. When ambient temperatures are expected to exceed 75°F, the resting heart rate of each worker will be measured prior to the start of onsite activities. The suggested frequency for physiological monitoring is provided in **Table 8-1**. The suggested and work-rest regimen is provided in **Table 8-2**.

Other factors, such as a worker's level of acclimation, level of physical fitness, and age, may increase or decrease his/her susceptibility to heat stress. Before assigning a task to an individual worker, these factors will be taken into account to ensure that the task will not endanger the worker's health. Sunscreen lotions will be provided and used per manufacturer's recommendations.

If a heat-related illness is suspected or observed, the affected person will be moved to a cool or shaded area and given plenty of liquids to consume. If symptoms of a heat stroke are observed, the victim will be cooled, and site personnel will immediately call 911.

8.2 COLD STRESS

Cold stress hazards are most likely to occur at low temperatures or low wind chill factors, with wet, windy conditions contributing to risk. As temperatures could fluctuate during these events, workers will be trained in signs and symptoms of cold stress and controls. If unexpected cold weather occurs, workers will be trained in signs and symptoms of cold stress and controls. Workers will be familiar with the signs and symptoms of cold stress, which include:

- ***Hypothermia***—Cold-induced decreasing of the core body temperature that produces shivering, numbness, drowsiness, and muscular weakness. If severe enough, it can lead to unconsciousness and death.

- ***Frostbite***—Constriction of blood vessels in the extremities, decreasing the supply of warming blood may result in formation of ice crystals in the tissues, causing tissue damage. Condition may range from frostnip, which is a numbing of extremities, to deep-freezing tissue beneath the skin. Symptoms include white or grayish skin, blisters, numbness, mental confusion, failing eyesight, fainting, shock, and cessation of breathing. Death may occur from heart failure.

Pain in the extremities may be the first warning of cold stress and precautions will be taken to reduce exposure. Maximum severe shivering will be taken as a sign of immediate danger to the worker and exposure to cold will be immediately terminated. Personnel exhibiting signs and symptoms of cold stress will be removed from the site and given appropriate first aid. Emergency medical services will be contacted if symptoms are severe (e.g., more than numbness of the extremities or shivering). Employees will not be immersed in water.

As a precautionary measure, employees will wear layers of loose-fitting clothing including insulated coveralls, head cover, gloves, and boots when temperatures fall below 40°F. Protection of the hands, feet, and head is particularly important because these are likely to be injured first by cold. However, actual injury to hands, feet, and head is not likely to occur without prior development of early signs of hypothermia such as numbing and shivering. Bare skin contact with cold surfaces (below 32°F) will be avoided. No continuous exposure to cold is permitted when the air speed and temperature results in an equivalent chill temperature of 26ºF or less. The equivalent chill temperature will be determined by the using the wind chill temperature shown in **Table 8-3**. Warm rest areas (support vehicles) will be provided. Air temperature and wind speed will be monitored at least every 4 hours at air temperatures below 45ºF.

Table 8-1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[(a)]

Adjusted Temperature (°F)[(b)]		Monitoring Interval (Minutes of Work)
90	Above 90	45
87.5	90	60
82.5	87.5	90
77.5	82.5	120
72.5	77.5	150

(a) Assumes work levels of 250 kilocalories/hour (e.g., a moderate work level). Consider increasing the frequency for heavier work rates. For the purpose of this chart, a normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

(b) Adjusted Air Temperature: Calculate the adjusted air temperature by using this equation:
AdjustedTemperature(°F) = *AirTemperature*(°F) + ([*13*] × [*% sunshine*]).
Measure the air temperature with a standard thermometer, with the bulb shielded from radiant heat. Estimate the percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow.
100% sunshine = no cloud cover and a sharp, distinct shadow.
0% sunshine = cloud cover and no shadows.

Adapted from: National Institute for Occupational Safety and Health/OSHA/U.S. Coast Guard/U.S. Environmental Protection Agency Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Chapter 8 (1985).

Table 8-2 Suggested Work-Rest Regimen

Ambient Temperature (°F)	Work Period (Hours)	Rest Period (Minutes)
70	3.0	15
75	2.5	15
80	2.0	15
85	1.5	15
90	1.0	15
95	0.5	15

Table 8-3 Wind Chill Temperature

Air Temperature (ºF)	Wind Speed (miles per hour)										
	0	5	10	15	20	25	30	35	40	45	50
40	40	36	34	32	30	29	28	28	27	26	26
35	35	31	27	25	24	23	22	21	20	19	19
30	30	25	21	19	17	16	15	14	13	12	12
25	25	19	15	13	11	9	8	7	6	5	4
20	20	13	9	6	4	3	1	0	-1	-2	-3
15	15	7	3	0	-2	-4	-5	-7	-8	-9	-10
10	10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17
5	5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24
0	0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31
-5	-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38
-10	-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45
-15	-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52
-20	-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60
-25	-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67
-30	-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74
-35	-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81
-40	-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88
-45	-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95

Green: **LITTLE DANGER** (frostbite occurs in >2 hours in dry, exposed skin)
Yellow: **INCREASED DANGER** (frostbite could occur in 45 minutes or less in dry, exposed skin)
Red: **GREAT DANGER** (frostbite could occur in 5 minutes or less in dry, exposed skin)
Adapted from: Sustaining Health and Performance in Cold Weather Operations: U.S. Army Research Institute of Environmental Medicine. October 2001.

9. STANDARD OPERATING PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

9.1 SITE RULES

During field activities, personnel will remain in verbal, radio, or mobile phone contact with each other. Mobile phones will not be used within the UXO exclusion zone. The Site Manager, SSHO, SUXOS, and UXOSO/UXO Quality Control Specialist (UXOQCS) will use mobile telephones and will be responsible for handling communications during emergencies that may arise. Safe work practices that will be followed by site workers include, but are not limited to, the following rules (which are described in more detail in pertinent sections of the APP):

- Working before or after daylight hours without special permission is prohibited.
- Eating and drinking, chewing gum or tobacco, and smoking in the exclusion zone is prohibited.
- Possessing, using, purchasing, distributing, or having controlled substances in their system throughout the day or during meal breaks is prohibited.
- Consuming or possessing alcoholic beverages is prohibited.
- Good housekeeping—The storage container and/or conex box will be kept as clean as possible including frequent trash removal and efforts to keep floors dry and clean. Work areas will be kept clear of debris, tools, or other potential tripping hazards.
- Immediately repair or replace defective PPE, but not while in the work area.
- Prescription drugs will not be taken by personnel unless specifically approved by a qualified occupational physician and then only within the support zone.
- Personnel onsite will use the buddy system; visual contact will be maintained between team members while in the work area.

9.2 DAILY STARTUP AND SHUTDOWN PROCEDURES

The following general protocols will be followed daily prior to start of work activities and are a summarization of activities, training, and documentation covered in pertinent sections of the APP for the Iona Island FUDS:

- The SSHO and/or UXOSO will review site conditions to establish whether modification of work and safety plans is needed.
- Personnel will be briefed and updated on new safety procedures as appropriate.
- Safety equipment will be checked for proper function.

- The SSHO and/or UXOSO will ensure that first aid equipment is readily available.

- The SSHO and/or UXOSO will conduct monitoring activities and document accordingly.

9.2.1 Material and Drum Handling

Loads will be lifted using the power of the leg muscles rather than the back, stomach, or arm muscles. The item will be approached to balance the load evenly. Backs will be kept straight and the arms nearly parallel with the body. The knees will be bent to grasp the load. Lifting will be done by straightening the legs without bending the body, holding the load as close to the body as possible and the back remaining as straight as possible. Risks associated with moving loads are described more fully in the APP and the AHAs; however, items likely moved will be restricted to equipment, supplies, and monitoring equipment. Bulky, heavy loads (approximately 50 pounds or greater) will be handled by at least two people, ensuring that the load is level and evenly distributed between personnel helping to carry it. Carriers will know the destination and path for the objects.

9.2.2 Spill Containment

Information pertaining to spill containment and emergency responses related to spills is presented in Section 9.2.3 of the APP.

9.2.3 Site Control Measures

Work zones are designed to prevent employees, visitors, and the surrounding environment from exposure to contamination during intrusive site activities. Site work zones will be established by the Field Manager/SSHO/SUXOS/UXOSO prior to initiating operations to control site access during site activities. Establishment of site work zones is based upon site conditions, activities, and exposure potentials. Exclusion zones for MEC-related activities refer to a larger, and more temporally-limited, area than the exclusion zone required for non-MEC-related activities.

9.2.3.1 Exclusion Zone

For MEC investigation activities, the exclusion zone/quantity distance arc will follow the approved ESP for the Iona Island FUDS. Minimum separation distances for this project will be determined in accordance with the final DDESB-approved ESP. As indicated in the ESP, the hazard fragment distances (HFDs) for non-essential personnel is based on an unintentional detonation. This HFD will be the exclusion zone around work areas when intrusive investigation work is being performed. The UXOSO will establish the exclusion zone around the work area.

9.2.4 Emergency Equipment and First Aid

Emergency equipment and first aid information is presented in Section 12.

10. PERSONNEL HYGIENE AND DECONTAMINATION

Fieldwork will be conducted in Level D or Modified Level D (when handling soil, sediment, or groundwater directly).

Site personnel will wash their hands prior to ingestion of food, liquids or any other hand-to-mouth activities and when leaving the area designated as the exclusion zone. Hand washing with potable water, soap, and paper towels will be available onsite. The site vehicles will also be furnished with hand sanitizer.

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11. EQUIPMENT DECONTAMINATION

It is imperative that equipment and vehicles that come into contact with contaminated site media be decontaminated before allowing the items to leave the work area. Downhole drilling equipment and sampling equipment will be decontaminated, and the decontamination liquid will be containerized.

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12. EMERGENCY EQUIPMENT AND FIRST AID

A complete first aid kit (1 per team or 25 personnel) meeting the requirements of a Type III, 16-unit or larger in a waterproof container will be readily available onsite and will contain, at a minimum, a pocket mouthpiece for CPR, absorbent compresses, adhesive bandages, adhesive tape, antiseptic swabs, burn gel, sterile pads, and a triangular bandage. The contents of the kit(s) will be evaluated and possibly modified for this specific project. At least one ANSI Z308.1-2015 first aid kit will be onsite and smaller first aid kit(s) will be transported in onsite vehicles.

The contents will be checked prior to their use for sterility and to replace expended items. The UXOSO and/or the SSHO will inventory the kit(s) at least every 3 months and document the results on the daily inspection form. Expended or non-sterile contents will be replaced with serviceable items.

Prior to the start of work, the UXOSO and or the SSHO will discuss with site personnel the prevention steps, symptoms, and medical personnel available to assist with injuries or questions on diseases, plants, or animals that could be encountered while working on this project. Diseases, plants, and animals are discussed in Section 2.

A working cell phone or radio with adequate signal in this area will be maintained onsite and fully charged at the start of each workday. Marine operations communication equipment is included in Appendix G of the APP, submitted as a subsequent addendum to the APP.

An appropriate fire extinguisher will be maintained in each vehicle. Site personnel are trained in the use of fire extinguishers commensurate with Table 6-1 of the APP.

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13. EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

Emergency response and contingency procedures are discussed in Section 9.2 of the APP including emergency contact telephone numbers. Directions and route to the nearest hospital are presented in Section 9.2 of the APP.

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14. REFERENCES

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Appendix F

Material Safety Data Sheets/Safety Data Sheets

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 05/12/2015 **Revision:** 05/12/2015

LIQUINOX

1 Identification of the Substance/mixture and of the Company/Undertaking

1.1 Product identifier
Trade name: LIQUINOX
Application of the substance / the preparation: Hand detergent.

1.2 Relevant identified uses of the substance or mixture and uses advised against:
No additional information available.

1.3 Details of the supplier of the Safety Data Sheet
Manufacturer/Supplier:
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040

Further information obtainable from: Product Safety Department.

1.4 Emergency telephone number:
ChemTel Inc.: (800)255-3924, +1 (813)248-0585

2 Hazards Identification

2.1 Classification of the substance or mixture
Classification according to Regulation (EC) No 1272/2008:
Classification according to Directive 67/548/EEC or Directive 1999/45/EC:

GHS07
Skin Irrit. 2, H315: Causes skin irritation.

Information concerning particular hazards for human and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
Classification system:
The classification is according to the latest editions of the EU-lists, and extended by company and literature data

2.2 Label elements
Labelling according to Regulation (EC) No 1272/2008:
The product is classified and labelled according to the CLP regulation.

Hazard pictograms:

GHS07

Signal word: Warning

Hazard-determining components of labelling:
Alkyl benzene sulfonic acid, sodium salt.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 05/12/2015 **Revision:** 05/12/2015

LIQUINOX

Hazard statements:
H315: Causes skin irritation.

Precautionary statements:

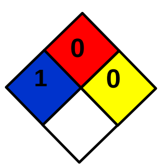
P332+P313: If skin irritation occurs: Get medical advice/attention.

P302+P352: IF ON SKIN: Wash with plenty of soap and water.

P501: Dispose of contents/container in accordance with local/regional/national/international regulations.

Other Hazard description:
WHMIS-classification and symbols:
D2B - Toxic material causing other toxic effects

NFPA ratings (scale 0 - 4)



Health = 1
Fire = 0
Reactivity = 0

HMIS-ratings (scale 0 - 4)

HEALTH	1	Health = 1
FIRE	0	Fire = 0
REACTIVITY	0	Reactivity = 0

2.3 Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

3 Composition/Information on Ingredients

3.2 Chemical characterization: Mixture
Description: Hazardous ingredients of mixture listed below.

Identifying Nos.	Description	Wt. %
CAS: 68081-81-2	Alkyl benzene sulfonic acid, sodium salt	10 - 25%
CAS: 1300-72-7 EINECS: 215-090-9	Sodium xylene sulphonate	2.5 - 10%
CAS: 84133-50-6	Alcohol Ethoxylate	2.5 - 10%
CAS: 68603-42-9 EINECS: 271-657-0	Coconut diethanolamide	2.5 - 10%
CAS: 17572-97-3 EINECS: 241-543-5	Ethylenediaminetetraacetic acid, tripotassium salt	2.5 - 10%

Additional information: For the wording of the listed risk phrases refer to section 16.

4 First Aid Measures

4.1 Description of first aid measures

General information:

Take affected persons out into the fresh air.

After inhalation:

Supply fresh air; consult doctor in case of complaints.

After skin contact:

Immediately wash with water and soap and rinse thoroughly for 30 minutes. If skin irritation continues, consult a doctor.

After eye contact:

Remove contact lenses if worn.

Rinse opened eye for at least 30 minutes under running water, lifting upper and lower lids occasionally. Immediately consult a doctor.

After swallowing:

Do not induce vomiting; call for medical help immediately. Rinse out mouth and then drink plenty of water.

A person vomiting while laying on their back should be turned onto their side.

4.2 Most important symptoms and effects, both acute and delayed:

Irritating, all routes of exposure.

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information available.

5 Firefighting Measures

5.1 Extinguishing media:

Suitable extinguishing agents:

CO_2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

5.2 Special hazards arising from the substance or mixture:

No additional information available.

5.3 Advice for firefighters:

Protective equipment:

Wear self-contained respiratory protective device.

Wear fully protective suit.

6 Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation.

Particular danger of slipping on leaked/spilled product.

6.2 Environmental precautions:

Dilute with plenty of water.

Do not allow to enter sewers/ surface or ground water.

6.3 Methods and material for containment and cleaning up:

Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).

Clean the affected area carefully; suitable cleaners are: Warm water

Dispose contaminated material as waste according to item 13. Ensure adequate ventilation.

6.4 Reference to other sections:

See Section 7 for information on safe handling.

See Section 8 for information on personal protection equipment.

See Section 13 for disposal information

7 Handling and Storage

7.1 Precautions for safe handling:

No special precautions are necessary if used correctly.

Information about fire - and explosion protection:

No special measures required.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 05/12/2015 **Revision:** 05/12/2015

LIQUINOX

7.2 Conditions for safe storage, including any incompatibilities:

Storage:

Requirements to be met by storerooms and receptacles: No special requirements.

Information about storage in one common storage facility: No special requirements.

Further information about storage conditions: None

7.3 Specific end use(s): No additional information available.

8 Exposure Controls/Personal Protection

8.1 Control parameters

Ingredients with limit values that require monitoring at the workplace:

The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.

Additional information: The lists valid during the making were used as basis.

8.2 Exposure controls:

Personal protective equipment:

General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.

Respiratory protection:

Not required under normal conditions of use.

Protection of hands:

Protective gloves

The glove material has to be impermeable and resistant to the product. Selection of the glove material should be based on the penetration time, rates of diffusion and the degradation of the glove material.

Material of gloves:

The selection of a suitable gloves does not only depend on the material, but also on the quality, and varies from manufacturer to manufacturer.

Penetration time of glove material:

The exact break through time has to be determined by the manufacturer of the protective gloves. DO NOT exceed the breakthrough time set by the Manufacturer.

For long term contact, gloves made of the following materials are considered suitable:

Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber (NR)
Neoprene gloves

Eye protection:

Safety glasses
Goggles recommended during refilling.

Body protection: Protective work clothing

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 05/12/2015 **Revision:** 05/12/2015

LIQUINOX

9 Physical and Chemical Properties

9.1 Information on basic physical and chemical properties:

General Information:	
Appearance:	
Form:	Liquid
Color:	Light Yellow
Odor:	Odorless
Odor threshold:	Not determined.
pH-value:	8.5
Change in condition:	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	100°C
Flash point:	Not applicable.
Flammability (solid, gaseous):	Not applicable.
Ignition temperature:	Not applicable.
Decomposition temperature:	Not determined.
Self-igniting:	Product is not selfigniting.
Danger of explosion:	Product does not present an explosion hazard.
Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
Vapor pressure at 20°C:	23 hPa
Density:	1.08 g/cm³
Relative density:	Not determined.
Vapor density:	Not determined.
Evaporation rate:	Not determined.
Solubility in / Miscibility with water:	Fully miscible.
Segregation coefficient (n-octanol/water):	Not determined.
Viscosity:	
Dynamic:	Not determined.
Kinematic:	Not determined.
Solvent content:	
Organic solvents:	Not determined.
Solids content:	Not determined.
9.2 Other information:	No additional information available.

10 Stability and Reactivity

10.1 Reactivity:

10.2 Chemical stability:

Thermal decomposition / conditions to be avoided:
No decomposition if used according to specifications.

10.3 Possibility of hazardous reactions:
Reacts with strong oxidizing agents. Reacts with strong acids.

10.4 Conditions to avoid:
No additional information available.

10.5 Incompatible materials:
No additional information available.

10.6 Hazardous decomposition products:
Carbon monoxide and carbon dioxide
Sulphur oxides (SOx)
Nitrogen oxides

11 Toxicological Information

11.1 Information on toxicological effects:
Toxicity data: Toxicity data is available for mixture:
Primary irritant effect:
On the skin: Irritating to skin and mucous membranes.
On the eye: Strong irritant with the danger of severe eye injury.
Sensitization: No sensitizing effects known.
Additional toxicological information:
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version: Irritant

12 Ecological Information

12.1 Toxicity:
Aquatic toxicity: No additional information available.
12.2 Persistence and degradability: Biodegradable.
12.3 Bioaccumulative potential: Does not accumulate in organisms.
12.4 Mobility in soil: No additional information available.
Additional ecological information:
General notes:
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water.
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
Must not reach sewage water or drainage ditch undiluted or un-neutralized.
12.5 Results of PBT and vPvB assessment:
PBT: Not applicable.
vPvB: Not applicable.
12.6 Other adverse effects: No additional information available.

13 Disposal Considerations

13.1 Waste treatment methods:
Recommendation:
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.
Uncleaned packaging:
Recommendation: Disposal must be made according to official regulations.
Recommended cleansing agents: Water, together with cleansing agents, if necessary.

14 Transport Information

14.1 UN-Number:
DOT, ADR, ADN, IMDG, IATA: Not Regulated

14.2 UN proper shipping name:
DOT, ADR, IMDG, IATA: Not Regulated

14.3 Transport hazard class(es):
DOT, ADR, IMDG, IATA:
Class: Not Regulated
Label: -

14.4 Packing group:
DOT, ADR, IMDG, IATA: Not Regulated

14.5 Environmental hazards:
Marine pollutant: No

14.6 Special precautions for user: Not applicable.

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

UN "Model Regulation": Not Regulated

15 Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:
United States (USA):
SARA:
Section 355 (extremely hazardous substances): None of the ingredient is listed.
Section 313 (Specific toxic chemical listings): None of the ingredient is listed.
TSCA (Toxic Substances Control Act): All ingredients are listed.

Proposition 65 (California):
Chemicals known to cause cancer: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for females: None of the ingredient is listed.
Chemicals known to cause reproductive toxicity for males: None of the ingredient is listed.
Chemicals known to cause developmental toxicity: None of the ingredient is listed.

Carcinogenic Categories:
EPA (Environmental Protection Agency): None of the ingredient is listed.
TLV (Threshold Limit Value established by ACGIH): None of the ingredient is listed.
NIOSH-Ca (National Institute for Occupational Safety and Health): None of the ingredient is listed.
OSHA-Ca (Occupational Safety & Health Administration): None of the ingredient is listed.
Canadá:
Canadian Domestic Substances List (DSL): All ingredients are listed.
Canadian Ingredient Disclosure list (limit 0.1%): None of the ingredient is listed.
Canadian Ingredient Disclosure list (limit 1%): None of the ingredient is listed.

15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other Information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Relevant phrases:
H315: Causes skin irritation.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Effective date: 05/12/2015 **Revision:** 05/12/2015

LIQUINOX

Abbreviations and Acronyms:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.
IMDG: International Maritime Code for Dangerous Goods.
DOT: US Department of Transportation.
IATA: International Air Transport Association.
GHS: Globally Harmonized System of Classification and Labelling of Chemicals.
ACGIH: American Conference of Governmental Industrial Hygienists.
NFPA: National Fire Protection Association (USA).
HMIS: Hazardous Materials Identification System (USA).
WHMIS: Workplace Hazardous Materials Information System (Canada).
VOC: Volatile Organic Compounds (USA, EU).
LC50: Lethal concentration, 50 percent.
LD50: Lethal dose, 50 percent.

SDS Created by:

Global Safety Management, Inc.
10006 Cross Creek Blvd
Tampa, FL, 33647
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Website: www.GSMSDS.com

Methanol

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 07/03/2013 Revision date: 11/15/2013 Supersedes: 10/02/2013 Version: 1.2

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form	:	Substance
Substance name	:	Methanol
CAS No	:	67-56-1
Product code	:	VT430
Formula	:	CH4O
Synonyms	:	acetone alcohol / alcohol C1 / alcohol, methyl / carbinol / colonial spirits / columbian spirits / green wood spirits / manhattan spirits / methyl alcohol / methyl hydrate / methyl hydroxide / methylen / methylol / monohydroxymethane / pyroligneous spirit / pyroxylic spirit / wood alcohol / wood naphtha

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Solvent

1.3. Details of the supplier of the safety data sheet

Val Tech Diagnostics, A Division of LabChem Inc
Jackson's Pointe Commerce Park Building 1000
1010 Jackson's Pointe Court
Zelienople, PA 16063
T 412-826-5230
F 724-473-0647

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Flam. Liq. 2	H225
Acute Tox. 3 (Oral)	H301
Acute Tox. 3 (Dermal)	H311
Acute Tox. 3 (Inhalation)	H331
STOT SE 1	H370

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :


GHS02


GHS06


GHS08

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H225 - Highly flammable liquid and vapour
H301+H311+H331 - Toxic if swallowed, in contact with skin or if inhaled
H370 - Causes damage to organs (liver, kidneys, central nervous system, optic nerve) (Dermal, oral)

Precautionary statements (GHS-US) :
P210 - Keep away from heat, sparks, open flames, hot surfaces. - No smoking
P233 - Keep container tightly closed
P240 - Ground/bond container and receiving equipment
P241 - Use explosion-proof electrical, ventilating, lighting equipment
P242 - Use only non-sparking tools
P243 - Take precautionary measures against static discharge
P260 - Do not breathe mist, vapours, spray
P264 - Wash exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P280 - Wear protective gloves, protective clothing, eye protection, face protection

P301 + P310 - IF SWALLOWED: immediately call a POISON CENTER or doctor/physician
P303 + P361 + P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
P304 + P340 - IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing
P330 - If swallowed, rinse mouth
P363 - Wash contaminated clothing before reuse
P370 + P378 - In case of fire: Use carbon dioxide (CO2), powder, alcohol-resistant foam for extinction
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed
P235 - Keep cool
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Mono-constituent

Name : Methanol

CAS No : 67-56-1

EC no : 200-659-6

EC index no : 603-001-00-X

Name	Product identifier	%	GHS-US classification
Methanol (Main constituent)	(CAS No) 67-56-1	100	Flam. Liq. 2, H225 Acute Tox. 3 (Oral), H301 Acute Tox. 3 (Dermal), H311 Acute Tox. 3 (Inhalation), H331 STOT SE 1, H370

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Never give alcohol to drink.

First-aid measures after inhalation : Remove the victim into fresh air. Immediately consult a doctor/medical service.

First-aid measures after skin contact : Wash immediately with lots of water. Soap may be used. Do not apply (chemical) neutralizing agents. Remove clothing before washing. Consult a doctor/medical service.

First-aid measures after eye contact : Rinse with water. Take victim to an ophthalmologist if irritation persists.

First-aid measures after ingestion : Rinse mouth with water. Give nothing to drink. Do not induce vomiting. Immediately consult a doctor/medical service. Call Poison Information Centre (www.big.be/antigif.htm). Ingestion of large quantities: immediately to hospital. Take the container/vomit to the doctor/hospital. Doctor: administration of chemical antidote. Doctor: gastric lavage.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : Slight irritation. EXPOSURE TO HIGH CONCENTRATIONS: Coughing. Symptoms similar to those listed under ingestion.

Symptoms/injuries after skin contact : Symptoms similar to those listed under ingestion. Slight irritation.

Symptoms/injuries after eye contact : Redness of the eye tissue. Lacrimation.

Symptoms/injuries after ingestion	: Nausea. Vomiting. AFTER ABSORPTION OF HIGH QUANTITIES: FOLLOWING SYMPTOMS MAY APPEAR LATER: Change in the haemogramme/blood composition. Headache. Feeling of weakness. Abdominal pain. Muscular pain. Central nervous system depression. Dizziness. Mental confusion. Drunkenness. Coordination disorders. Disturbed motor response. Disturbances of consciousness. Visual disturbances. Blindness. Respiratory difficulties. Cramps/uncontrolled muscular contractions.
Chronic symptoms	: ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Skin rash/inflammation. Headache. Disturbed tactile sensibility. Visual disturbances. Sleeplessness. Gastrointestinal complaints. Cardiac and blood circulation effects.

4.3. Indication of any immediate medical attention and special treatment needed

Hospitalize at once. Until victim can be cared for by specialized staff:

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	: Preferably: alcohol resistant foam. Water spray. BC powder. Carbon dioxide.
Unsuitable extinguishing media	: Solid water jet ineffective as extinguishing medium.

5.2. Special hazards arising from the substance or mixture

Fire hazard	: DIRECT FIRE HAZARD. Highly flammable. Gas/vapour flammable with air within explosion limits. INDIRECT FIRE HAZARD. May be ignited by sparks.
Explosion hazard	: DIRECT EXPLOSION HAZARD. Gas/vapour explosive with air within explosion limits. INDIRECT EXPLOSION HAZARD. may be ignited by sparks. Reactions with explosion hazards: see "Reactivity Hazard".
Reactivity	: On heating: release of toxic/corrosive/combustible gases/vapours (formaldehyde). Upon combustion: CO and CO2 are formed. Violent to explosive reaction with (some) metal powders and with (strong) oxidizers. Violent exothermic reaction with (some) acids and with (some) halogens compounds.

5.3. Advice for firefighters

Firefighting instructions	: Cool tanks/drums with water spray/remove them into safety. Do not move the load if exposed to heat. Take account of toxic fire-fighting water. Use water moderately and if possible collect or contain it.
Protection during firefighting	: Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	: Gas-tight suit.
Emergency procedures	: Keep upwind. Mark the danger area. Consider evacuation. Close doors and windows of adjacent premises. Stop engines and no smoking. No naked flames or sparks. Spark- and explosionproof appliances and lighting equipment. Keep containers closed. Wash contaminated clothes.

6.1.2. For emergency responders

Protective equipment	: Equip cleanup crew with proper protection.
Emergency procedures	: Stop leak if safe to do so. Ventilate area.

6.2. Environmental precautions

Prevent soil and water pollution. Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

For containment	: Contain released substance, pump into suitable containers. Consult "Material-handling" to select material of containers. Plug the leak, cut off the supply. Dam up the liquid spill. Try to reduce evaporation. Measure the concentration of the explosive gas-air mixture. Dilute combustible/toxic gases/vapours with water spray. Take account of toxic/corrosive precipitation water. Provide equipment/receptacles with earthing. Do not use compressed air for pumping over spills.
Methods for cleaning up	: Take up liquid spill into a non combustible material e.g.: sand, earth, vermiculite slaked lime or soda ash. Scoop absorbed substance into closing containers. See "Material-handling" for suitable container materials. Carefully collect the spill/leftovers. Damaged/cooled tanks must be emptied. Do not use compressed air for pumping over spills. Clean contaminated surfaces with an excess of water. Take collected spill to manufacturer/competent authority. Wash clothing and equipment after handling.

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Handle uncleaned empty containers as full ones. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Do not use compressed air for pumping over. Use spark-/explosionproof appliances and lighting system. Take precautions against electrostatic charges. Keep away from naked flames/heat. Keep away from ignition sources/sparks. Observe strict hygiene. Keep container tightly closed. Measure the concentration in the air regularly. Work under local exhaust/ventilation.

Hygiene measures : Do not eat, drink or smoke when using this product. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Incompatible products : Strong oxidizers. Strong bases. Strong acids. Acid anhydrides. Acid chlorides.

Incompatible materials : Direct sunlight. Heat sources. Sources of ignition.

Heat and ignition sources : KEEP SUBSTANCE AWAY FROM: heat sources. ignition sources.

Prohibitions on mixed storage : KEEP SUBSTANCE AWAY FROM: combustible materials. oxidizing agents. (strong) acids. (strong) bases. halogens. amines. water/moisture.

Storage area : Store at room temperature. Keep out of direct sunlight. Store in a dry area. Keep container in a well-ventilated place. Fireproof storeroom. Keep locked up. Provide for a tub to collect spills. Provide the tank with earthing. Unauthorized persons are not admitted. Aboveground. Meet the legal requirements.

Special rules on packaging : SPECIAL REQUIREMENTS: closing. dry. clean. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.

Packaging materials : SUITABLE MATERIAL: steel. stainless steel. iron. glass. MATERIAL TO AVOID: lead. aluminium. zinc. polyethylene. PVC.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Methanol (67-56-1)		
USA ACGIH	ACGIH TWA (ppm)	200 ppm
USA ACGIH	ACGIH STEL (ppm)	200 ppm
USA OSHA	OSHA PEL (TWA) (mg/m³)	260 mg/m³
USA OSHA	OSHA PEL (TWA) (ppm)	200 ppm

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Keep concentrations well below lower explosion limits.

Personal protective equipment : Safety glasses. Protective clothing. Gloves. Full protective flameproof clothing. Face shield.

Materials for protective clothing : GIVE EXCELLENT RESISTANCE: No data available. GIVE GOOD RESISTANCE: polyethylene/ethylenevinylalcohol. styrene-butadiene rubber. viton. GIVE LESS RESISTANCE: chloroprene rubber. chlorinated polyethylene. natural rubber. nitrile rubber/PVC. GIVE POOR RESISTANCE: leather. neoprene. nitrile rubber. polyethylene. PVA. PVC. polyurethane.

Hand protection : Gloves.

Eye protection : Combined eye and respiratory protection. Safety glasses.

Skin and body protection : Head/neck protection. Protective clothing.

Respiratory protection : Gas mask with filter type AX at conc. in air > exposure limit. Wear gas mask with filter type A if conc. in air > exposure limit. High vapour/gas concentration: self-contained respirator.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Appearance	:	Liquid.
Molecular mass	:	32.04 g/mol
Colour	:	Colourless.
Odour	:	Characteristic odour. Mild odour. Pleasant odour. Alcohol odour. Commercial/unpurified substance: Irritating/pungent odour.
Odour threshold	:	2000 - 8800 ppm 2620 - 11528 mg/m³
pH	:	No data available
Relative evaporation rate (butylacetate=1)	:	4.1
Relative evaporation rate (ether=1)	:	6.3
Melting point	:	-98 °C
Freezing point	:	No data available
Boiling point	:	65 °C
Flash point	:	11 °C
Critical temperature	:	240 °C
Self ignition temperature	:	455 °C
Decomposition temperature	:	No data available
Flammability (solid, gas)	:	No data available
Vapour pressure	:	128 hPa
Vapour pressure at 50 °C	:	552 hPa
Critical pressure	:	79547 hPa
Relative vapour density at 20 °C	:	1.1
Relative density	:	0.79
Relative density of saturated gas/air mixture	:	1.0
Density	:	792 kg/m³
Solubility	:	Soluble in water. Soluble in ethanol. Soluble in ether. Soluble in acetone. Soluble in chloroform. Water: Complete Ethanol: Complete Ether: Complete Acetone: Complete
Log Pow	:	-0.77 (Experimental value; Other,Experimental value; Other)
Log Kow	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	0.6 mPa.s (20 °C)
Explosive properties	:	No data available
Oxidising properties	:	No data available
Explosive limits	:	5.5 - 36.5 vol %

9.2. Other information

Minimum ignition energy	:	0.14 mJ
Saturation concentration	:	166 g/m³
VOC content	:	100 %
Other properties	:	Clear. Hygroscopic. Volatile. Substance has neutral reaction.

SECTION 10: Stability and reactivity

10.1. Reactivity

On heating: release of toxic/corrosive/combustible gases/vapours (formaldehyde). Upon combustion: CO and CO2 are formed. Violent to explosive reaction with (some) metal powders and with (strong) oxidizers. Violent exothermic reaction with (some) acids and with (some) halogens compounds.

10.2. Chemical stability

Hygroscopic.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Direct sunlight. High temperature. Incompatible materials. Open flame. Sparks. Overheating.

10.5. Incompatible materials

Strong oxidizers. Strong bases. Strong acids. Peroxides. Acid anhydrides. Acid chlorides.

10.6. Hazardous decomposition products

Carbon dioxide. Carbon monoxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Toxic if swallowed. Toxic in contact with skin. Toxic if inhaled.

Methanol (\f)67-56-1	
LD50 oral rat	> 5000 mg/kg (1187-2769 mg/kg bodyweight; Rat; Rat)
LD50 dermal rabbit	15800 mg/kg (Rabbit)
LC50 inhalation rat (mg/l)	85 mg/l/4h (Rat)
LC50 inhalation rat (ppm)	64000 ppm/4h (Rat)

Skin corrosion/irritation	: Not classified
Serious eye damage/irritation	: Not classified
Respiratory or skin sensitisation	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: Causes damage to organs (liver, kidneys, central nervous system, optic nerve) (Dermal, oral).
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified
Symptoms/injuries after inhalation	: Slight irritation. EXPOSURE TO HIGH CONCENTRATIONS: Coughing. Symptoms similar to those listed under ingestion.
Symptoms/injuries after skin contact	: Symptoms similar to those listed under ingestion. Slight irritation.
Symptoms/injuries after eye contact	: Redness of the eye tissue. Lacrimation.
Symptoms/injuries after ingestion	: Nausea. Vomiting. AFTER ABSORPTION OF HIGH QUANTITIES: FOLLOWING SYMPTOMS MAY APPEAR LATER: Change in the haemogramme/blood composition. Headache. Feeling of weakness. Abdominal pain. Muscular pain. Central nervous system depression. Dizziness. Mental confusion. Drunkenness. Coordination disorders. Disturbed motor response. Disturbances of consciousness. Visual disturbances. Blindness. Respiratory difficulties. Cramps/uncontrolled muscular contractions.
Chronic symptoms	: ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Skin rash/inflammation. Headache. Disturbed tactile sensibility. Visual disturbances. Sleeplessness. Gastrointestinal complaints. Cardiac and blood circulation effects.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general	: Classification concerning the environment: not applicable.
Ecology - air	: TA-Luft Klasse 5.2.5/I.
Ecology - water	: Not harmful to fishes (LC50(96h) >1000 mg/l). Not harmful to invertebrates (Daphnia) (EC50 (48h) > 1000 mg/l). Not harmful to algae (EC50 (72h) >1000 mg/l). Slightly harmful to bacteria (EC50: 100 - 1000 mg/l). Inhibition of activated sludge.

Methanol (67-56-1)	
LC50 fishes 1	15400 mg/l (96 h; Lepomis macrochirus; Lethal)
EC50 Daphnia 1	> 10000 mg/l (48 h; Daphnia magna; Lethal)
LC50 fish 2	10800 mg/l 96 h; Salmo gairdneri (Oncorhynchus mykiss)
EC50 Daphnia 2	24500 mg/l (48 h; Daphnia magna)
Threshold limit other aquatic organisms 1	6600 mg/l (16 h; Pseudomonas putida)
Threshold limit algae 1	530 mg/l (192 h; Microcystis aeruginosa)
Threshold limit algae 2	8000 mg/l (168 h; Scenedesmus quadricauda)

12.2. Persistence and degradability

Methanol (67-56-1)	
Persistence and degradability	Readily biodegradable in water. Biodegradable in the soil.
Biochemical oxygen demand (BOD)	0.6 - 1.12 g O^2/g substance
Chemical oxygen demand (COD)	1.42 g O^2/g substance
ThOD	1.5 g O^2/g substance
BOD (% of ThOD)	0.8 % ThOD

12.3. Bioaccumulative potential

Methanol (67-56-1)	
BCF fish 1	< 10 (Leuciscus idus)
Log Pow	-0.77 (Experimental value; Other,Experimental value; Other)
Bioaccumulative potential	Low potential for bioaccumulation (BCF < 500).

12.4. Mobility in soil

Methanol (67-56-1)	
Surface tension	0.023 N/m (20 °C)

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Recycle by distillation. Incinerate under surveillance with energy recovery. Do not discharge into drains or the environment. Obtain the consent of pollution control authorities before discharging to wastewater treatment plants.

Additional information : LWCA (the Netherlands): KGA category 06. Hazardous waste according to Directive 2008/98/EC.

SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1230 Methanol, 3, II

UN-No.(DOT) : 1230

DOT NA no. : UN1230

DOT Proper Shipping Name : Methanol

Department of Transportation (DOT) Hazard Classes : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120

Hazard labels (DOT) : 3 - Flammable liquid

DOT Symbols : D - Proper shipping name for domestic use only, or to and from Canada

Packing group (DOT) : II - Medium Danger

DOT Special Provisions (49 CFR 172.102)	:	IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized. T7 - 4 178.274(d)(2) Normal............ 178.275(d)(3) TP2 - a. The maximum degree of filling must not exceed the degree of filling determined by the following: (image) Where: tr is the maximum mean bulk temperature during transport, tf is the temperature in degrees celsius of the liquid during filling, and a is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maximum mean bulk temperature during transportation (tr) both in degrees celsius. b. For liquids transported under ambient conditions may be calculated using the formula: (image) Where: d15 and d50 are the densities (in units of mass per unit volume) of the liquid at 15 C (59 F) and 50 C (122 F), respectively.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	150
DOT Packaging Non Bulk (49 CFR 173.xxx)	:	202
DOT Packaging Bulk (49 CFR 173.xxx)	:	242
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	1 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	60 L
DOT Vessel Stowage Location	:	B - (i) The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) ‘‘On deck only’’ on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.
DOT Vessel Stowage Other	:	40 - Stow ‘‘clear of living quarters’’

Additional information

Other information	:	No supplementary information available.
State during transport (ADR-RID)	:	as liquid.

ADR

Transport document description	:	UN 1230 Methanol, 3 (6.1), II, (D/E)
Packing group (ADR)	:	II
Class (ADR)	:	3 - Flammable liquid
Hazard identification number (Kemler No.)	:	336
Classification code (ADR)	:	FT1
Danger labels (ADR)	:	3 - Flammable liquids 6.1 - Toxic substances

Orange plates :

Tunnel restriction code	:	D/E

Transport by sea

UN-No. (IMDG)	:	1230
Class (IMDG)	:	3 - Flammable liquids
Subsidiary risk (IMDG)	:	6.1
EmS-No. (1)	:	F-E
MFAG-No	:	19
EmS-No. (2)	:	S-D

Air transport

UN-No.(IATA)	:	1230
Class (IATA)	:	3 - Flammable Liquids

Packing group (IATA)	:	II - Medium Danger
Subsidiary risk (IATA)	:	6.1

SECTION 15: Regulatory information

15.1. US Federal regulations

Methanol (67-56-1)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings)	
RQ (Reportable quantity, section 304 of EPA's List of Lists) :	5000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Fire hazard

15.2. International regulations

CANADA

Methanol (67-56-1)	
Listed on the Canadian DSL (Domestic Substances List) inventory.	
WHMIS Classification	Class B Division 2 - Flammable Liquid Class D Division 2 Subdivision A - Very toxic material causing other toxic effects Class D Division 2 Subdivision B - Toxic material causing other toxic effects

EU-Regulations

No additional information available

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Flam. Liq. 2	H225
Acute Tox. 3 (Inhalation)	H331
Acute Tox. 3 (Dermal)	H311
Acute Tox. 3 (Oral)	H301
STOT SE 1	H370
STOT SE 1	H370
STOT SE 1	H370

Full text of H-phrases: see section 16

Classification according to Directive 67/548/EEC or 1999/45/EC

F; R11
T; R23/24/25
T; R39/23/24/25

Full text of R-phrases: see section 16

15.2.2. National regulations

Methanol (67-56-1)
Listed on the Canadian Ingredient Disclosure List

15.3. US State regulations

Methanol(67-56-1)	
U.S. - California - Proposition 65 - Developmental Toxicity	Yes
No significance risk level (NSRL)	23000 µg/day

SECTION 16: Other information

Full text of H-phrases: see section 16:

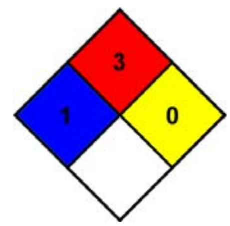
Acute Tox. 3 (Dermal)	Acute toxicity (dermal), Category 3
Acute Tox. 3 (Inhalation)	Acute toxicity (inhal.), Category 3

Acute Tox. 3 (Oral)	Acute toxicity (oral), Category 3
Flam. Liq. 2	Flammable liquids, Category 2
STOT SE 1	Specific target organ toxicity — single exposure, Category 1
H225	Highly flammable liquid and vapour
H301	Toxic if swallowed
H311	Toxic in contact with skin
H331	Toxic if inhaled
H370	Causes damage to organs

NFPA health hazard : 1 - Exposure could cause irritation but only minor residual injury even if no treatment is given.

NFPA fire hazard : 3 - Liquids and solids that can be ignited under almost all ambient conditions.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 2 Moderate Hazard - Temporary or minor injury may occur

Flammability : 3 Serious Hazard

Physical : 0 Minimal Hazard

Personal Protection : H

SDS US ValTech

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

Safety Data Sheet

Material Name: Gasoline All Grades **SDS No. 9950**
US GHS

Synonyms: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Flammable Liquid - Category 2
Skin Corrosion/Irritation - Category 2
Germ Cell Mutagenicity - Category 1B
Carcinogenicity - Category 1B
Toxic to Reproduction - Category 1A
Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)
Specific Target Organ Toxicity (Repeat Exposure) - Category 1 (liver, kidneys, bladder, blood, bone marrow, nervous system)
Aspiration Hazard - Category 1
Hazardous to the Aquatic Environment – Acute Hazard - Category 3

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

DANGER

Hazard Statements

Highly flammable liquid and vapour.
Causes skin irritation.
May cause genetic defects.
May cause cancer.
May damage fertility or the unborn child.
May cause respiratory irritation.
May cause drowsiness or dizziness.
Causes damage to organs (liver, kidneys, bladder, blood, bone marrow, nervous system) through prolonged or repeated exposure.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Do not breathe mist/vapours/spray.
Use only outdoors or in well-ventilated area.
Do not eat, drink or smoke when using this product.
Avoid release to the environment.

Response

In case of fire: Use water spray, fog, dry chemical fire extinguishers or hand held fire extinguisher.
IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash before reuse. If skin irritation occurs, get medical advice/attention.
IF exposed or concerned: Get medical advice/attention.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.
Get medical advice/attention if you feel unwell.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Do not induce vomiting.

Storage

Store in a well-ventilated place.
Keep cool. Keep container tightly closed.
Store locked up.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
86290-81-5	Gasoline, motor fuel	100
108-88-3	Toluene	1-25
106-97-8	Butane	<10
1330-20-7	Xylenes (o-, m-, p- isomers)	1-15
95-63-6	Benzene, 1,2,4-trimethyl-	<6
64-17-5	Ethyl alcohol	0-10
100-41-4	Ethylbenzene	<3
71-43-2	Benzene	0.1-4.9

110-54-3	Hexane	0.5-4

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or gaseous extinguishing agent.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

USE ONLY AS A MOTOR FUEL.
DO NOT SIPHON BY MOUTH

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

Incompatibilities

Keep away from strong oxidizers.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

Gasoline, motor fuel (86290-81-5)

ACGIH: 300 ppm TWA
500 ppm STEL

Toluene (108-88-3)

ACGIH: 20 ppm TWA
OSHA: 200 ppm TWA; 375 mg/m3 TWA
150 ppm STEL; 560 mg/m3 STEL
NIOSH: 100 ppm TWA; 375 mg/m3 TWA
150 ppm STEL; 560 mg/m3 STEL

Butane (106-97-8)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases: Alkane C1-4)
OSHA: 800 ppm TWA; 1900 mg/m3 TWA
NIOSH: 800 ppm TWA; 1900 mg/m3 TWA

Xylenes (o-, m-, p- isomers) (1330-20-7)

ACGIH: 100 ppm TWA
150 ppm STEL
OSHA: 100 ppm TWA; 435 mg/m3 TWA
150 ppm STEL; 655 mg/m3 STEL

Benzene, 1,2,4-trimethyl- (95-63-6)

NIOSH: 25 ppm TWA; 125 mg/m3 TWA

Ethyl alcohol (64-17-5)

ACGIH: 1000 ppm STEL
OSHA: 1000 ppm TWA; 1900 mg/m3 TWA
NIOSH: 1000 ppm TWA; 1900 mg/m3 TWA

Ethylbenzene (100-41-4)

ACGIH:	20 ppm TWA
OSHA:	100 ppm TWA; 435 mg/m3 TWA 125 ppm STEL; 545 mg/m3 STEL
NIOSH:	100 ppm TWA; 435 mg/m3 TWA 125 ppm STEL; 545 mg/m3 STEL

Benzene (71-43-2)

ACGIH:	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA:	5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA
NIOSH:	0.1 ppm TWA 1 ppm STEL

Hexane (110-54-3)

ACGIH:	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA:	500 ppm TWA; 1800 mg/m3 TWA
NIOSH:	50 ppm TWA; 180 mg/m3 TWA

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Translucent, straw-colored or light yellow	**Odor:**	Strong, characteristic aromatic hydrocarbon odor. Sweet-ether like
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)	**Vapor Density:**	AP 3-4
Boiling Point:	85-437 °F (39-200 °C)	**Melting Point:**	ND
Solubility (H2O):	Negligible to Slight	**Specific Gravity:**	0.70-0.78
Evaporation Rate:	10-11	**VOC:**	ND
Percent Volatile:	100%	**Octanol/H2O Coeff.:**	ND
Flash Point:	-45 °F (-43 °C)	**Flash Point Method:**	PMCC
Upper Flammability Limit (UFL):	7.6%	**Lower Flammability Limit (LFL):**	1.4%
Burning Rate:	ND	**Auto Ignition:**	>530°F (>280°C)

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Gasoline, motor fuel (86290-81-5)

Inhalation LC50 Rat >5.2 mg/L 4 h; Oral LD50 Rat 14000 mg/kg; Dermal LD50 Rabbit >2000 mg/kg

Toluene (108-88-3)

Inhalation LC50 Rat 12.5 mg/L 4 h; Inhalation LC50 Rat >26700 ppm 1 h; Oral LD50 Rat 636 mg/kg; Dermal LD50 Rabbit 8390 mg/kg; Dermal LD50 Rat 12124 mg/kg

Butane (106-97-8)

Inhalation LC50 Rat 658 mg/L 4 h

Xylenes (o-, m-, p- isomers) (1330-20-7)
Inhalation LC50 Rat 5000 ppm 4 h; Inhalation LC50 Rat 47635 mg/L 4 h; Oral LD50 Rat 4300 mg/kg; Dermal LD50 Rabbit >1700 mg/kg

Benzene, 1,2,4-trimethyl- (95-63-6)
Inhalation LC50 Rat 18 g/m3 4 h; Oral LD50 Rat 3400 mg/kg; Dermal LD50 Rabbit >3160 mg/kg

Ethyl alcohol (64-17-5)
Oral LD50 Rat 7060 mg/kg; Inhalation LC50 Rat 124.7 mg/L 4 h

Ethylbenzene (100-41-4)
Inhalation LC50 Rat 17.2 mg/L 4 h; Oral LD50 Rat 3500 mg/kg; Dermal LD50 Rabbit 15354 mg/kg

Benzene (71-43-2)
Inhalation LC50 Rat 13050-14380 ppm 4 h; Oral LD50 Rat 1800 mg/kg

Hexane (110-54-3)
Inhalation LC50 Rat 48000 ppm 4 h; Oral LD50 Rat 25 g/kg; Dermal LD50 Rabbit 3000 mg/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Moderate irritant. Contact with liquid or vapor may cause irritation.

Potential Health Effects: Ingestion

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This product may cause genetic defects.

Carcinogenicity

A: General Product Information

May cause cancer.

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

B: Component Carcinogenicity

Gasoline, motor fuel (86290-81-5)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

Toluene (108-88-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999]; Monograph 47 [1989] (Group 3 (not classifiable))

Xylenes (o-, m-, p- isomers) (1330-20-7)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Monograph 71 [1999]; Monograph 47 [1989] (Group 3 (not classifiable))

Ethyl alcohol (64-17-5)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
IARC: Monograph 100E [in preparation] (in alcoholic beverages); Monograph 96 [2010] (in alcoholic beverages) (Group 1 (carcinogenic to humans))

Ethylbenzene (100-41-4)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
IARC: Monograph 77 [2000] (Group 2B (possibly carcinogenic to humans))

Benzene (71-43-2)

ACGIH: A1 - Confirmed Human Carcinogen
OSHA: 5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA
NIOSH: potential occupational carcinogen
NTP: Known Human Carcinogen (Select Carcinogen)
IARC: Monograph 100F [in preparation]; Supplement 7 [1987]; Monograph 29 [1982] (Group 1 (carcinogenic to humans))

Reproductive Toxicity

This product is suspected of damaging fertility or the unborn child.

Specified Target Organ General Toxicity: Single Exposure

This product may cause drowsiness or dizziness.

Specified Target Organ General Toxicity: Repeated Exposure

This product causes damage to organs through prolonged or repeated exposure.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Very toxic to aquatic life with long lasting effects. Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Gasoline, motor fuel (86290-81-5)

Test & Species		Conditions
96 Hr LC50 Alburnus alburnus	119 mg/L [static]	
96 Hr LC50 Cyprinodon variegatus	82 mg/L [static]	
72 Hr EC50 Pseudokirchneriella subcapitata	56 mg/L	
24 Hr EC50 Daphnia magna	170 mg/L	

Toluene (108-88-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	15.22-19.05 mg/L [flow-through]	1 day old
96 Hr LC50 Pimephales promelas	12.6 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	5.89-7.81 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	14.1-17.16 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	5.8 mg/L [semi-static]	
96 Hr LC50 Lepomis macrochirus	11.0-15.0 mg/L [static]	
96 Hr LC50 Oryzias latipes	54 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.2 mg/L [semi-static]	
96 Hr LC50 Poecilia reticulata	50.87-70.34 mg/L [static]	
96 Hr EC50 Pseudokirchneriella subcapitata	>433 mg/L	
72 Hr EC50 Pseudokirchneriella subcapitata	12.5 mg/L [static]	
48 Hr EC50 Daphnia magna	5.46 - 9.83 mg/L [Static]	
48 Hr EC50 Daphnia magna	11.5 mg/L	

Xylenes (o-, m-, p- isomers) (1330-20-7)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	13.4 mg/L [flow-through]	

96 Hr LC50 Oncorhynchus mykiss	2.661-4.093 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	13.5-17.3 mg/L	
96 Hr LC50 Lepomis macrochirus	13.1-16.5 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	19 mg/L	
96 Hr LC50 Lepomis macrochirus	7.711-9.591 mg/L [static]	
96 Hr LC50 Pimephales promelas	23.53-29.97 mg/L [static]	
96 Hr LC50 Cyprinus carpio	780 mg/L [semi-static]	
96 Hr LC50 Cyprinus carpio	>780 mg/L	
96 Hr LC50 Poecilia reticulata	30.26-40.75 mg/L [static]	
48 Hr EC50 water flea	3.82 mg/L	
48 Hr LC50 Gammarus lacustris	0.6 mg/L	

Benzene, 1,2,4-trimethyl- (95-63-6)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	7.19-8.28 mg/L [flow-through]	
48 Hr EC50 Daphnia magna	6.14 mg/L	

Ethyl alcohol (64-17-5)

Test & Species		Conditions
96 Hr LC50 Oncorhynchus mykiss	12.0 - 16.0 mL/L [static]	
96 Hr LC50 Pimephales promelas	>100 mg/L [static]	
96 Hr LC50 Pimephales promelas	13400 - 15100 mg/L [flow-through]	
48 Hr LC50 Daphnia magna	9268 - 14221 mg/L	
24 Hr EC50 Daphnia magna	10800 mg/L	
48 Hr EC50 Daphnia magna	2 mg/L [Static]	

Ethylbenzene (100-41-4)

Test & Species		Conditions
96 Hr LC50 Oncorhynchus mykiss	11.0-18.0 mg/L [static]	
96 Hr LC50 Oncorhynchus mykiss	4.2 mg/L [semi-static]	
96 Hr LC50 Pimephales promelas	7.55-11 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	32 mg/L [static]	
96 Hr LC50 Pimephales promelas	9.1-15.6 mg/L [static]	
96 Hr LC50 Poecilia reticulata	9.6 mg/L [static]	
72 Hr EC50 Pseudokirchneriella subcapitata	4.6 mg/L	
96 Hr EC50 Pseudokirchneriella subcapitata	>438 mg/L	
72 Hr EC50 Pseudokirchneriella subcapitata	2.6 - 11.3 mg/L [static]	

96 Hr EC50 Pseudokirchneriella subcapitata	1.7 - 7.6 mg/L [static]
48 Hr EC50 Daphnia magna	1.8 - 2.4 mg/L

Benzene (71-43-2)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	10.7-14.7 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]	
96 Hr LC50 Lepomis macrochirus	22.49 mg/L [static]	
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]	
96 Hr LC50 Pimephales promelas	22330-41160 µg/L [static]	
96 Hr LC50 Lepomis macrochirus	70000-142000 µg/L [static]	
72 Hr EC50 Pseudokirchneriella subcapitata	29 mg/L	
48 Hr EC50 Daphnia magna	8.76 - 15.6 mg/L [Static]	
48 Hr EC50 Daphnia magna	10 mg/L	

Hexane (110-54-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	2.1-2.98 mg/L [flow-through]	
24 Hr EC50 Daphnia magna	>1000 mg/L	

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

Component Marine Pollutants

This material contains one or more of the following chemicals required by US DOT to be identified as marine pollutants.

Component	CAS #	
Gasoline, motor fuel	86290-81-5	DOT regulated marine pollutant

DOT Information

Shipping Name: Gasoline
UN #: 1203 **Hazard Class:** 3 **Packing Group:** II
Placard:

* * * Section 15 - Regulatory Information * * *

Regulatory Information

A: Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Toluene (108-88-3)
SARA 313: 1.0 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Xylenes (o-, m-, p- isomers) (1330-20-7)
SARA 313: 1.0 % de minimis concentration
CERCLA: 100 lb final RQ; 45.4 kg final RQ

Benzene, 1,2,4-trimethyl- (95-63-6)
SARA 313: 1.0 % de minimis concentration

Ethylbenzene (100-41-4)
SARA 313: 0.1 % de minimis concentration
CERCLA: 1000 lb final RQ; 454 kg final RQ

Benzene (71-43-2)
SARA 313: 0.1 % de minimis concentration
CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

Hexane (110-54-3)

SARA 313: 1.0 % de minimis concentration
CERCLA: 5000 lb final RQ; 2270 kg final RQ

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

Component Marine Pollutants

This material contains one or more of the following chemicals required by US DOT to be identified as marine pollutants.

Component	CAS #	
Gasoline, motor fuel	86290-81-5	DOT regulated marine pollutant

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Gasoline, motor fuel	86290-81-5	No	No	No	No	Yes	No
Toluene	108-88-3	Yes	Yes	Yes	Yes	Yes	No
Butane	106-97-8	Yes	Yes	Yes	Yes	Yes	No
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	Yes	Yes	Yes	Yes	No
Benzene, 1,2,4-trimethyl-	95-63-6	No	Yes	Yes	Yes	Yes	No
Ethyl alcohol	64-17-5	Yes	Yes	Yes	Yes	Yes	No
Ethylbenzene	100-41-4	Yes	Yes	Yes	Yes	Yes	No
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	No
Hexane	110-54-3	No	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.
WARNING! This product contains a chemical known to the state of California to cause reproductive/developmental effects.

Component Analysis - WHMIS IDL

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Toluene	108-88-3	1 %
Butane	106-97-8	1 %
Benzene, 1,2,4-trimethyl-	95-63-6	0.1 %
Ethyl alcohol	64-17-5	0.1 %
Ethylbenzene	100-41-4	0.1 %
Benzene	71-43-2	0.1 %
Hexane	110-54-3	1 %

Additional Regulatory Information

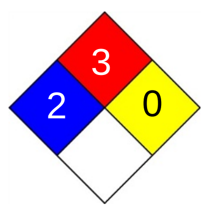
Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Gasoline, motor fuel	86290-81-5	No	DSL	EINECS
Toluene	108-88-3	Yes	DSL	EINECS
Butane	106-97-8	Yes	DSL	EINECS
Xylenes (o-, m-, p- isomers)	1330-20-7	Yes	DSL	EINECS
Benzene, 1,2,4-trimethyl-	95-63-6	Yes	DSL	EINECS
Ethyl alcohol	64-17-5	Yes	DSL	EINECS
Ethylbenzene	100-41-4	Yes	DSL	EINECS
Benzene	71-43-2	Yes	DSL	EINECS
Hexane	110-54-3	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	2	
Fire	3	
Reactivity	0	



HMIS® Hazard Rating

Health	2	Moderate
Fire	3	Serious
Physical	0	Minimal
		*Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration., NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

End of Sheet

Safety Data Sheet

Material Name: Diesel Fuel, All Types

SDS No. 9909
US GHS

Synonyms: Ultra Low Sulfur Diesel; Low Sulfur Diesel; No. 2 Diesel; Motor Vehicle Diesel Fuel; Non-Road Diesel Fuel; Locomotive/Marine Diesel Fuel

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Flammable Liquids - Category 3
Skin Corrosion/Irritation – Category 2
Germ Cell Mutagenicity – Category 2
Carcinogenicity - Category 2
Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)
Aspiration Hazard – Category 1
Hazardous to the Aquatic Environment, Acute Hazard – Category 3

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

DANGER

Hazard Statements

Flammable liquid and vapor.
Causes skin irritation.
Suspected of causing genetic defects.
Suspected of causing cancer.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking
Keep container tightly closed.
Ground/bond container and receiving equipment.

Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Avoid breathing fume/mist/vapours/spray.

Response

In case of fire: Use water spray, fog or foam to extinguish.
IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.
If swallowed: Immediately call a poison center or doctor. Do NOT induce vomiting.
IF exposed or concerned: Get medical advice/attention.

Storage

Store in a well-ventilated place. Keep cool.
Keep container tightly closed.
Store locked up.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
68476-34-6	Fuels, diesel, no. 2	100
91-20-3	Naphthalene	<0.1

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and the area of the body burned.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO_2, water spray, fire fighting foam, and other gaseous agents.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a combustible liquid. Keep away from heat, sparks, excessive temperatures and open flame! No smoking or open flame in storage, use or handling areas. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Keep away from strong oxidizers.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: 100 mg/m3 TWA (inhalable fraction and vapor, as total hydrocarbons, listed under Diesel fuel)
Skin - potential significant contribution to overall exposure by the cutaneous route (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH:	10 ppm TWA
	15 ppm STEL
	Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA:	10 ppm TWA; 50 mg/m3 TWA
NIOSH:	10 ppm TWA; 50 mg/m3 TWA
	15 ppm STEL; 75 mg/m3 STEL

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Clear, straw-yellow.	**Odor:**	Mild, petroleum distillate odor
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	0.009 psia @ 70 °F (21 °C)	**Vapor Density:**	>1.0
Boiling Point:	320 to 690 °F (160 to 366 °C)	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	0.83-0.876 @ 60°F (16°C)
Evaporation Rate:	Slow; varies with conditions	**VOC:**	ND
Percent Volatile:	100%	**Octanol/H2O Coeff.:**	ND
Flash Point:	>125 °F (>52 °C) minimum	**Flash Point Method:**	PMCC
Upper Flammability Limit (UFL):	7.5	**Lower Flammability Limit (LFL):**	0.6
Burning Rate:	ND	**Auto Ignition:**	494°F (257°C)

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Naphthalene (91-20-3)

Inhalation LC50 Rat >340 mg/m3 1 h; Oral LD50 Rat 490 mg/kg; Dermal LD50 Rat >2500 mg/kg; Dermal LD50 Rabbit >20 g/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Contact with eyes may cause mild irritation.

Potential Health Effects: Ingestion

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This material has been positive in a mutagenicity study.

Carcinogenicity

A: General Product Information

Suspected of causing cancer.

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

B: Component Carcinogenicity

Fuels, diesel, no. 2 (68476-34-6)

ACGIH:	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH:	A4 - Not Classifiable as a Human Carcinogen
NTP:	Reasonably Anticipated To Be A Human Carcinogen (Possible Select Carcinogen)
IARC:	Monograph 82 [2002] (Group 2B (possibly carcinogenic to humans))

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity repeat exposure effects.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Fuels, diesel, no. 2 (68476-34-6)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	35 mg/L [flow-through]	

Naphthalene (91-20-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	5.74-6.44 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	1.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	0.91-2.82 mg/L [static]	
96 Hr LC50 Pimephales promelas	1.99 mg/L [static]	

96 Hr LC50 Lepomis macrochirus	31.0265 mg/L [static]
72 Hr EC50 Skeletonema costatum	0.4 mg/L
48 Hr LC50 Daphnia magna	2.16 mg/L
48 Hr EC50 Daphnia magna	1.96 mg/L [Flow through]
48 Hr EC50 Daphnia magna	1.09 - 3.4 mg/L [Static]

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

DOT Information

Shipping Name: Diesel Fuel

NA #: 1993 **Hazard Class:** 3 **Packing Group:** III

Placard:

* * * Section 15 - Regulatory Information * * *

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Naphthalene (91-20-3)

CERCLA: 100 lb final RQ; 45.4 kg final RQ

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the de minimis levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right- To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Fuels, diesel, no. 2	68476-34-6	No	No	No	Yes	No	No
Naphthalene	91-20-3	Yes	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

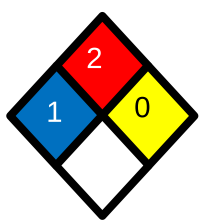
Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Fuels, diesel, no. 2	68476-34-6	Yes	DSL	EINECS
Naphthalene	91-20-3	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	1
Fire	2
Reactivity	0



HMIS® Hazard Rating

Health	1*	Slight
Fire	2	Moderate
Physical	0	Minimal
		*Chronic

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; ADG = Australian Code for the Transport of Dangerous Goods by Road and Rail; ADR/RID = European Agreement of Dangerous Goods by Road/Rail; AS = Standards Australia; DFG = Deutsche Forschungsgemeinschaft; DOT = Department of Transportation; DSL = Domestic Substances List; EEC = European Economic Community; EINECS = European Inventory of Existing Commercial Chemical Substances; ELINCS = European List of Notified Chemical Substances; EU = European Union; HMIS = Hazardous Materials Identification System; IARC = International Agency for Research on Cancer; IMO = International Maritime Organization; IATA = International Air Transport Association; MAK = Maximum Concentration Value in the Workplace; NDSL = Non-Domestic Substances List; NFPA = National Fire Protection Association; NOHSC = National Occupational Health & Safety Commission; NTP = National Toxicology Program; STEL = Short-term Exposure Limit; TDG = Transportation of Dangerous Goods; TLV = Threshold Limit Value; TSCA = Toxic Substances Control Act; TWA = Time Weighted Average

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

End of Sheet

Safety Data Sheet
Premium #7H Hydraulic Oil

Section1: Product and Company Identification

PRODUCT NAME:	Super ATF
MSDS NUMBER:	778846
INTENDED USE:	Automatic Transmission Fluid
MANUFACTURER/SUPPLIER:	Phillips 66 Lubricants P.O. Box 4428 Houston, TX 77210
EMERGENCY HEALTH AND SAFETY NUMBER:	Chemtrec: 800-424-9300 (24 hours)
CUSTOMER SERVICE:	U.S.: 800-822-6457 or International: +1-83-2486-3363
TECHNICAL INFORMATION:	1-877-445-9198
SDS INFORMATION:	800-762-0942 SDS@P66.com www.Phillips66.com

Section 2: Hazard(s) Identification

This material is not considered hazardous according to OSHA criteria.

NFPA

Section 3: Composition / Information on Ingredients

Component	CASRN	Concentration[1]
Lubricant Base Oil (Petroleum)	VARIOUS	>90
Additives	Proprietary	<10

[1] All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Section 4: First Aid Measures

EYE CONTACT: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

SKIN CONTACT: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.

INHALATION (BREATHING): First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

INGESTION (SWALLOWING): First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

NOTES TO PHYSICIAN: Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Conditions which may be aggravated by exposure include skin disorders

Section 5: Fire-Fighting Measures

NFPA 704 HAZARD CLASS

Health: 0 **Flammability:** 1 **Instability:** 0 (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

UNUSUAL FIRE & EXPLOSION HAZARDS: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

FIRE FIGHTING INSTRUCTIONS: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

HAZARDOUS COMBUSTION PRODUCTS: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

Section 6: Accidental Release Measures

PERSONAL PRECAUTIONS: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

ENVIRONMENTAL PRECAUTIONS: Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

METHODS FOR CONTAINMENT AND CLEAN-UP: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken.

Section 7: Handling and Storage

PRECAUTIONS FOR SAFE HANDLING: Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

Spills will produce extremely slippery surfaces. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

CONDITIONS FOR SAFE STORAGE: Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Section 8: Exposure Controls / Personal Protection

Component	ACGIH	OSHA	Other
Lubricant Base Oil (Petroleum)	TWA: 5mg/m³ STEL: 10 mg/m³ as Oil Mist, if Generated	TWA: 5mg/m³ as Oil Mist, if Generated	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

ENGINEERING CONTROLS: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

EYE/FACE PROTECTION: The use of eye protection that meets or exceeds ANSI Z.87.1 is recommended to protect against potential eye contact, irritation, or injury. Depending on conditions of use, a face shield may be necessary.

SKIN/HAND PROTECTION: The use of gloves impervious to the specific material handled is advised to prevent skin contact. Users should check with manufacturers to confirm the breakthrough performance of their products. Suggested protective materials: Nitrile

RESPIRATORY PROTECTION: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

Section 9: Physical and Chemical Properties

NOTE: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

APPEARANCE:	Red
PHYSICAL FORM:	Liquid
ODOR:	Petroleum
ODOR THRESHOLD:	No data
pH:	Not applicable
VAPOR PRESSURE:	<1 mm Hg
VAPOR DENSITY (AIR=1):	>1
INITIAL BOILING POINT/RANGE:	No data
MELTING/FREEZING POINT:	No data
SOLUBILITY IN WATER:	Negligible
PARTITION COEFFICIENT (N-OCTANOL/WATER) (KOW):	No data
SPECIFIC GRAVITY (WATER=1):	0.85 - 0.86 @ 60ºF (15.6ºC)
BULK DENSITY:	7.08 - 7.16 lbs/gal
VISCOSITY:	6.8 - 7.7 cSt @ 100°C; 30.0 - 34.0 cSt @ 40°C
PERCENT VOLATILE:	Negligible
EVAPORATION RATE (NBUAC=1):	<1

FLASH POINT: Minimum 315 °F / 157 °C
TEST METHOD: Pensky-Martens Closed Cup (PMCC), ASTM D93, EPA 1010
LOWER EXPLOSIVE LIMITS (VOL % IN AIR): No data
UPPER EXPLOSIVE LIMITS (VOL % IN AIR): No data
AUTO-IGNITION TEMPERATURE: No data

Section 10: Stability and Reactivity

STABILITY: Stable under normal ambient and anticipated conditions of use.

CONDITIONS TO AVOID: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

MATERIALS TO AVOID (INCOMPATIBLE MATERIALS): Avoid contact with strong oxidizing agents and strong reducing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Not anticipated under normal conditions of use.

HAZARDOUS POLYMERIZATION: Not known to occur.

Section 11: Toxicological Information

Information on Toxicological Effects of Substance/Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Aspiration Hazard: Not expected to be an aspiration hazard.

Skin Corrosion/Irritation: Not expected to be irritating. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Not expected to be irritating.

Symptoms of Overexposure: Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea.

Skin Sensitization: This product is not classified as a sensitizer, but contains low concentrations (0.1 - < 1%) of a known skin sensitizer.

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): Not expected to cause organ effects from single exposure.

Specific Target Organ Toxicity (Repeated Exposure): Not expected to cause organ effects from repeated exposure.

Carcinogenicity: Not expected to cause cancer.

Germ Cell Mutagenicity: Not expected to cause heritable genetic effects.

Reproductive Toxicity: Not expected to cause reproductive toxicity.

Information on Toxicological Effects of Components

Lubricant Base Oil (Petroleum)

Carcinogenicity: The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

Section 12: Ecological Information

Toxicity:

All acute aquatic toxicity studies on samples of lubricant base oils show acute toxicity values greater than 100 mg/L for invertebrates, algae and fish. These tests were carried out on water accommodated fractions and the results are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions. Classification: No classified hazards.

PERSISTENCE AND DEGRADABILITY: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

BIOACCUMULATIVE POTENTIAL: Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

MOBILITY IN SOIL: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

OTHER ADVERSE EFFECTS: None anticipated.

Section 13: Disposal Considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations.

This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the MSDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.

This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

Section 14: Transport Information

U.S. Department of Transportation (DOT)

Shipping Description: ***Not regulated***
Note: ***If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)***

International Maritime Dangerous Goods (IMDG)

Shipping Description: ***Not regulated***
Note: ***U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 25.***

International Civil Aviation Org. / International Air Transport Assoc. (ICAO/IATA)

UN/ID #: ***Not regulated***
Note: ***U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 24.***

	LTD. QTY	Passenger Aircraft	Cargo Aircraft Only
Packaging Instruction #:	---	---	---
Max. Net Qty. Per Package:	---	---	---

Section 15: Regulatory Information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)

Acute Health: No
Chronic Health: No
Fire Hazard: No
Pressure Hazard: No
Reactive Hazard: No

CERCLA/SARA - Section 313 and 40 CFR 372:
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds):
This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65:
Warning: This material may contain detectable quantities of the following chemicals, known to the State of California to cause cancer, birth defects or other reproductive harm, and which may be subject to the warning requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5):

Component	Type of Toxicity
Ethyl Acrylate	Cancer

International Hazard Classification

Canada:
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the Regulations.

WHMIS Hazard Class:
None

National Chemical Inventories
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA
All components are either on the DSL, or are exempt from DSL listing requirements

U.S. Export Control Classification Number: EAR99

Section 16: Other Information

DATE OF ISSUE:	28-Mar-2012
STATUS:	FINAL
PREVIOUS ISSUE DATE:	02-Sep-2008
REVISED SECTIONS OR BASIS FOR REVISION:	Manufacturer (Section 1)
SDS NUMBER:	778846

GUIDE TO ABBREVIATIONS:
ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:
The information presented in this Material Safety Data Sheet is based on data believed to be accurate as of the date this Material Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

Safety Data Sheet

Material Name: Hess 10W30 Motor Oil **SDS No. 8957**
US GHS

Synonyms: Valvoline Product Code 52670413

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Skin Corrosion/Irritation – Category 2
Specific Target Organ Toxicity – Category 3 (narcosis)
Carcinogenicity - Category 1B

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

WARNING

Hazard Statements

Causes skin irritation.
May cause cancer.
May cause drowsiness or dizziness.

Precautionary Statements

Prevention

Wash hands and forearms thoroughly after handling.
Wear protective gloves/protective clothing/eye protection.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Avoid breathing fume/mist/vapors/spray.
Use only outdoors or in a well-ventilated area.

Response

If on skin: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.
If exposed or concerned: Get medical advice/attention.
If inhaled: Remove person to fresh air and keep in a position comfortable for breathing. Call poison center or doctor if you feel unwell.

Storage

Store locked up.
Store in a well-ventilated place.
Keep container tightly closed.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
64742-65-0	Petroleum distillates, solvent dewaxed heavy paraffinic	83-93

Petroleum-based lubricating oil with detergent/dispersant engine oil package with zinc compounds.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

If symptoms develop, move individual away from exposure and into fresh air. Flush eyes gently with water while holding eyelids apart. If symptoms persist or there is visual difficulty, seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash exposed area with soap and water. If symptoms persist, seek medical attention. Launder clothing before reuse.

First Aid: Ingestion

Seek medical attention. If individual is drowsy or unconscious, do not give anything by mouth; place individual on the left side with the head down. Contact a physician, medical facility, or poison control center for advice about whether to induce vomiting. If possible, do not leave individual unattended.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

First Aid: Notes to Physician

Acute aspiration of large amounts of oil-laden material may produce a serious aspiration hazard. Patients who aspirate these oils should be followed for the development of long-term sequelae. Repeated aspiration of mineral oil can produce chronic inflammation of the lungs (i.e. lipoid pneumonia) that may progress to pulmonary fibrosis. Symptoms are often subtle and radiological changes appear worse than clinical abnormalities. Occasionally, persistent cough, irritation of the upper respiratory tract, shortness of breath with exertion, fever, and bloody sputum occur. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities. Preexisting disorders of the following organs (or organ systems) may be aggravated by exposure to this material: skin.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.
Never use welding or cutting torch on or near drum (even empty) because product (even just residue) can ignite explosively. No special fire hazards are known to be associated with this product. Dense smoke may be generated while burning.

Hazardous Combustion Products
May form: carbon dioxide and carbon monoxide, oxides of sulfur, nitrogen and phosphorous, various hydrocarbons.

Extinguishing Media
SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO_2, water spray, fire fighting foam, or gaseous extinguishing agent.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media
None

Fire Fighting Equipment/Instructions
Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization
Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up
Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

SMALL SPILL: Absorb liquid on vermiculite, floor absorbent or other absorbent material. Persons not wearing proper personal protective equipment should be excluded from area of spill.

LARGE SPILL: Prevent run-off to sewers, streams, or other bodies of water. If run-off occurs, notify authorities as required, that a spill has occurred. Persons not wearing proper personal protective equipment should be excluded from area of spill until clean-up has been completed.

Emergency Measures
Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment
Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Avoid contact with: acids, halogens, strong oxidizing agents.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

ACGIH, OSHA, and NIOSH have not developed exposure limits for any of this product's components.

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Not normally required. However, wear resistant gloves such as nitrile rubber to prevent irritation which may result from prolonged or repeated skin contact with product.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

To prevent repeated or prolonged skin contact, wear impervious clothing and boots. Wear normal work clothing covering arms and legs.

Hygiene Measures

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Dry, clear and bright	**Odor:**	None
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	ND	**Vapor Density:**	ND
Boiling Point:	>425 °F (218.3°C) @ 760.00 mmHg	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	0.881 @ 60°F (16°C)
Evaporation Rate:	Slower than ethyl ether	**VOC:**	ND
Viscosity:	<= 3300.0 cps @ -20°C; 10.0 - 11.0 cst @ 100°C	**Octanol/H2O Coeff.:**	ND
Flash Point:	430 °F (221.1 °C)	**Flash Point Method:**	COC
Upper Flammability Limit (UFL):	ND	**Lower Flammability Limit (LFL):**	ND
Burning Rate:	ND	**Auto Ignition:**	ND

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

None

Incompatible Products

Avoid contact with: acids, halogens, strong oxidizing agents.

Hazardous Decomposition Products

May form: aldehydes, carbon dioxide and carbon monoxide, hydrogen sulfide, oxides of sulfur, nitrogen and phosphorus, toxic fumes, various hydrocarbons.

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if large amounts are swallowed.

B: Component Analysis - LD50/LC50

Petroleum distillates, solvent dewaxed heavy paraffinic (64742-65-0)

Inhalation LC50 Rat >4.7 mg/L 4 h; Oral LD50 Rat >5000 mg/kg; Dermal LD50 Rabbit >5000 mg/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

May cause mild skin irritation. Prolonged or repeated contact may dry the skin. Symptoms include redness, burning, drying and cracking of the skin, and skin burns. Additional symptoms of skin contact include: acne. Passage of this material into the body through the skin is possible, but it is unlikely that this would result in harmful effects during safe handling and use.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

May cause mild eye irritation. Symptoms include stinging, tearing, and redness.

Potential Health Effects: Ingestion

Swallowing small amounts of this material during normal handling is not likely to cause harmful effects. Swallowing large amounts may be harmful.

Potential Health Effects: Inhalation

It is possible to breathe this material under certain conditions of handling and use (for example, during heating, spraying, or stirring). Breathing small amounts of this material during normal handling is not likely to cause harmful effects. Breathing large amounts may be harmful. Symptoms usually occur at air concentrations higher than the recommended exposure limits.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This product is not reported to have any mutagenic effects.

Carcinogenicity

A: General Product Information

May cause cancer.

Used motor oil has been shown to cause skin cancer in laboratory animal continually exposed by repeated applications.

B: Component Carcinogenicity

None of this product's components are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity repeat exposure effects.

Aspiration Respiratory Organs Hazard

Acute aspiration of large amounts of oil-laden material may produce a serious aspiration hazard.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Petroleum distillates, solvent dewaxed heavy paraffinic (64742-65-0)

Test & Species		Conditions
96 Hr LC50 Oncorhynchus mykiss	>5000 mg/L	
48 Hr EC50 Daphnia magna	>1000 mg/L	

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

DOT Information

Shipping Name: Not Regulated

* * * Section 15 - Regulatory Information * * *

Regulatory Information

Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	--	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

ZINC C1-C14 ALKYLDITHIOPHOSPHATE (CAS No. 68649-42-3)

State Regulations

Component Analysis - State

None of this product's components are listed on the state lists from CA, MA, MN, NJ, PA, or RI.

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Petroleum distillates, solvent dewaxed heavy paraffinic	64742-65-0	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	1	
Fire	1	
Reactivity	0	

HMIS® Hazard Rating

Health	1*	Slight
Fire	1	Slight
Physical	0	Minimal
		*Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration., NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

End of Sheet

SAFETY DATA SHEET

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier — DEET

Synonyms: N,N-Diethyl-m-toluamide, DETA

Chemical Abstracts Registry No: 134-62-3

1.2. Relevant identified uses of the substance or mixture and uses advised against

Insect repellent

1.3. Details of the supplier of the safety data sheet

Vertellus Performance Materials Inc.
2110 High Point Road
Greensboro, NC 27403 USA

e-mail Address: sds@vertellus.com

1.4. Emergency telephone number

Vertellus: 1-336-292-1781
CHEMTREC (USA): 1-800-424-9300 (collect calls accepted)
CHEMTREC (International): 1-703-527-3887 (collect calls accepted)
NRCC (China): +86 532 83889090

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

(According to Regulation (EC) No 1272/2008)	(According to Directive 67/548/EEC)
Skin Corrosion/Irritation Category 2 Serious Eye Irritation Category 2 Environmental Chronic Category 3 Acute Toxicity Oral Category 4	Symbol: Xn, Xi Risk Phrases: R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. R36/38: Irritating to eyes and skin. R22: Harmful if swallowed. Safety Phrases: S2: Keep out of the reach of children. S61: Avoid release to the environment. Refer to safety data sheet.

2.2. Label elements

Hazard Symbols (Pictogram):

Signal Word: Warning

Hazard Precautions:
H315 - Causes skin irritation.
H302 - Harmful if swallowed.
H319 - Causes serious eye irritation.
H412 - Harmful to aquatic life with long lasting effects.

Prevention Precautionary Statements:
P270 - Do not eat, drink or smoke when using this product.
P273 - Avoid release to the environment.

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	P280 - Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Precautionary Statements:	P302+P352 - IF ON SKIN: Wash with plenty of soap and water. P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P337+P313 - If eye irritation persists: Get medical advice/attention. P362 - Take off contaminated clothing and wash before reuse.
Storage Precautionary Statements:	Not required.
Disposal Precautionary Statements:	P501 - Dispose of contents/container in accordance with local/regional/national/international regulation for hazardous wastes.

2.3. Other hazards

Other Hazards: Not applicable.

SECTION 3: Composition/information on ingredients

3.1. Substances or 3.2. Mixtures

Ingredient	CAS Number	Concentration (weight %)	EC Number	CLP Inventory/ Annex VI	EU DSD Classification (67/548/EEC)	EU CLP Classification (1272/2008)
N,N-Diethyl-m-toluamide (DEET)	134-62-3	~ 100	205-149-7	616-018-00-2	Xi, Xn R52/53- R36/38- R22	Aquatic Chronic 3; H412 Acute Tox. 4; H302 Eye Irrit. 2; H319 Skin Irrit. 2; H315

NOTE: See Section 8 for exposure limit data for these ingredients. See Section 15 for trade secret information (where applicable). See Section 16 for the full text of the R-phrases above.

SECTION 4: First aid measures

4.1. Description of first aid measures

Skin Contact:	Wash thoroughly after skin contact.
Eye Contact:	Immediately flush eyes with plenty of water. Get medical attention, if irritation persists.
Inhalation:	Remove from exposure. If not breathing, give artificial respiration and call a physician. Seek medical advice if symptoms persist.
Ingestion:	If swallowed, contact physician or poison control center immediately.

4.2 Most important symptoms and effects, both acute and delayed

Acute:	May be harmful if ingested in sufficient quantities. Contact with skin may cause slight irritation. Moderately irritating to eyes. High gas, vapor, or mist concentrations may be harmful if inhaled.
Delayed Effects:	None known.

4.3. Indication of any immediate medical attention and special treatment needed

Note to Physician: No specific indications. Treatment should be based on the judgment of the physician in response to the reactions of the patient.

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SECTION 5: Firefighting measures

5.1. Extinguishing media

Appropriate Extinguishing Media:	Foam, dry chemical, carbon dioxide, water spray

5.2. Special hazards arising from the substance or mixture

Hazardous Products of Combustion:	Combustion will produce carbon monoxide, carbon dioxide and oxides of nitrogen.
Potential for Dust Explosion:	Not applicable.
Special Flammability Hazards:	Not applicable.

5.3. Advice for firefighters

Basic Fire Fighting Guidance:	Wear self-contained breathing apparatus and protective clothing. Normal firefighting procedures may be used.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Evacuation Procedures:	Isolate the hazard area and deny entry to unnecessary and unprotected personnel.
Special Instructions:	See Section 8 for personal protective equipment recommendations. Remove all contaminated clothing to prevent further absorption. Decontaminate affected personnel using the first aid procedures in Section 4. Leather shoes that have been saturated must be discarded.

6.2. Environmental precautions

Prevent releases to soils, drains, sewers and waterways.

6.3. Methods and material for containment and cleaning up

Remove all ignition sources. Ventilate the area of spill or leak. Wear protective equipment during clean-up. Contain spilled liquid with sand or vermiculite and place in chemical waste container. Prevent runoff from entering drains, sewers, and streams. After collection of material, flush area with water. Dispose of contents & container in accordance with local, regional, national or international regulations.

6.4. Reference to other sections

Refer to section 8 for information on selecting personal protective equipment. Refer to section 13 for information on spilled product, absorbent and clean up material disposal instructions.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for Unique Hazards:	Not applicable.
Practices to Minimize Risk:	Wear appropriate protective equipment when performing maintenance on contaminated equipment. Wash hands thoroughly before eating or smoking after handling this material. Do not eat, drink or smoke in work areas. Prevent contact with incompatible materials. Avoid spills and keep away from drains. Handle in a manner to prevent generation of aerosols, vapors or dust clouds.

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Special Handling Equipment:	Not applicable.

7.2. Conditions for safe storage, including any incompatibilities

Storage Precautions & Recommendations:	This product should be stored at ambient temperature in a dry, well-ventilated location. Keep container closed when not in use.
Dangerous Incompatibility Reactions:	Incompatible with oxidizing materials.
Incompatibilities with Materials of Construction:	None known

7.3. Specific end use(s)

If a chemical safety assessment has been completed an exposure scenario is attached as an annex to this Safety Data Sheet. Refer to this annex for the specific exposure scenario control parameters for uses identified in subsection 1.2.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational Exposure Limit:	Not applicable.
Air Monitoring Method:	Collection Media: Tenax®; Analysis Method: LCMS/MS

8.2. Exposure controls

Also see the annex to this SDS (if applicable) for specific exposure scenario controls.

Other Engineering Controls:	All operations should be conducted in well-ventilated conditions. Local exhaust ventilation should be provided.
Personal Protective Equipment:	Impervious gloves, boots, and clothing, chemical goggles or face shield where necessary, and a NIOSH approved chemical cartridge respirator or supplied air breathing apparatus.
Respirator Caution:	Observe OSHA regulations for respirator use (29 CFR 1910.134). Air-purifying respirators must not be used in oxygen-deficient atmospheres.
Thermal Hazards:	Not applicable.
Environmental Exposure Controls:	The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance, State & Odor (ambient temperature):	Clear, oily liquid with mild, characteristic odor		
Molecular Formula:	$C_{12}H_{17}NO$	Molecular Weight:	191.27
Vapor Pressure:	0.0048 mm Hg @ 32.4°C	Evaporation Rate:	< 1 (Butyl Acetate = 1)
Specific Gravity or Density:	0.998 @ 20°C	Vapor Density (air = 1):	6.7

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Boiling Point:	284.2°C @ 760 mm Hg	Freezing / Melting Point:	-43°C (-45°F) (pour point)
Solubility in Water:	11.2 mg/mL @ 25°C	Octanol / Water Coefficient:	2.4 @ 22°C
pH:	No data available.	Odor Threshold:	No data available.
Viscosity:	21.86 cS @ 20°C	Autoignition Temperature:	> 200°C
Flash Point and Method:	291°F (144°C) Tag Closed Cup	Flammable Limits:	No data available.
Flammability (solid, gas):	Not applicable.	Decomposition Temperature:	No data available.
Explosive Properties:	Not explosive.	Oxidizing Properties:	Not an oxidizer.

SECTION 10: Stability and reactivity

10.1. Reactivity	Not classified as dangerously reactive.
10.2. Chemical stability	Stable
10.3. Possibility of hazardous reactions	Will not occur.
10.4. Conditions to avoid	Uncontrolled exposure to high temperatures.
10.5. Incompatible materials	Incompatible with oxidizing materials.
10.6. Hazardous decomposition products	Combustion will produce carbon monoxide, carbon dioxide and oxides of nitrogen.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute Oral LD_{50}:	1892 mg/kg (rat)	[KEY] Moore 2000a
Acute Dermal LD_{50}:	> 5000 mg/kg (rat)	[KEY] Moore 2001a
Acute Inhalation LC_{50}:	> 2.02 mg/L/4 hr (rat)	[KEY] Moore 2000b
Skin Irritation:	Slightly irritating to skin. [Moore 2000c]	
Eye Irritation:	Moderately irritating to eyes. [Moore 2001b]	
Skin Sensitization:	Not a sensitizer [Moore 2001c]	
Mutagenicity:	*In vitro* gene mutation in bacteria: Negative. *In vitro* cytogenicity in mammalian cells: Negative. *In vitro* gene mutation in mammalian cells: Negative in two separate studies. [DEET CAR 2010]	
Reproductive / Developmental Toxicity:	There were no effects on reproduction in a 2-generation study in rats. No teratogenic effects observed in the studies up to maternally toxic doses; embryotoxicity was only expressed as decreased fetal body weights (rats). [DEET CAR 2010]	
Carcinogenicity:	2-year rat and 18-month mouse studies: no treatment related tumors observed at highest dose tested. [DEET CAR 2010]	
Target Organs:	No data available.	

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Primary Route(s) of Exposure:	Skin contact and absorption, eye contact, and inhalation. Ingestion is not likely to be a primary route of exposure.
Most important symptoms and effects, both acute and delayed	May be harmful if ingested in sufficient quantities. Contact with skin may cause slight irritation. Moderately irritating to eyes. High gas, vapor, or mist concentrations may be harmful if inhaled. Delayed Effects: None known.
Additive or Synergistic effects:	None known.

SECTION 12: Ecological information

12.1. Toxicity	EC_{50} (48h) *Daphnia* = 75 ppm	[KEY] Forbis 1985
	LC_{50} (96h) *Oncorhynchus mykiss* (rainbow trout) = 97 mg/L	[KEY] Palmer 2002
	NOEC (72-hr) *Pseudokirchneriella subcapitata* (algae) = 8 mg/L	[KEY] Desjardins 2002
	LC_{50} *Colinus virginianus* (Northern bobwhite quail) = 1375 mg/kg	[KEY] Grimes 1989
12.2. Persistence and degradability	Readily biodegradable. [Schaefer 2002]	
12.3. Bioaccumulative potential	Bioconcentration is not expected to occur.	
12.4. Mobility in soil	This material is expected to have high mobility in soil. It absorbs weakly to most soil types.	
12.5. Results of PBT and vPvB assessment	This substance is not a PBT or vPvB.	
12.6. Other adverse effects	BCF = 22; Koc = 43.3 [Schaefer 2002; Lezotte 2002]	

SECTION 13: Disposal considerations

13.1. Waste treatment methods

US EPA Waste Number:	Non-Hazardous
Waste Disposal:	NOTE: Generator is responsible for proper waste characterization. State hazardous waste regulations may differ substantially from federal regulations. Dispose of this material responsibly, and in accordance with standard practice for disposal of potentially hazardous materials as required by applicable international, national, regional, state or local laws, and environmental protection duty of care principles. Do NOT dump into any sewers, on the ground, or into any body of water. For disposal within the EC, the appropriate classification code according to the European Community List of Wastes should be used. Note that disposal regulations may also apply to empty containers and equipment rinsates.

SECTION 14: Transport information

The following information applies to all shipping modes (DOT/IATA/ICAO/IMDG/ADR/RID/ADN), unless otherwise indicated:

14.1. UN number	Not applicable	14.2. UN proper shipping name	Insect repellent other than agricultural (DEET)
14.3. Transport hazard class(es)	Not applicable	14.4. Packing group	Not applicable
14.5. Environmental hazards	Not applicable		
14.6. Special precautions for user	Not applicable.		
NA Emergency Guidebook Numbers:	Not applicable	IMDG EMS:	Not applicable;
14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code			Not applicable.

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SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Chemical Inventory Lists:	Status:		
TSCA:	Listed	EINECS:	205-149-7
Canada(DSL/NDSL):	DSL	Japan:	(3)-1321
Korea:	KE-10492	Australia:	Listed
China:	Listed	Philippines:	Listed
Taiwan:	Listed	New Zealand:	Listed

German Water Hazard Classification: ID Number 4679, hazard class 2 - hazard to waters *(N,N-Diethyl-m-toluamid)*

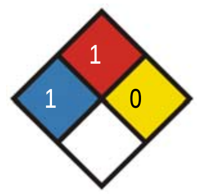
SARA 313: Not applicable.

Reportable Quantities: Not applicable.

State Regulations: This product is regulated under various pesticide laws (e.g., US FIFRA, EU Biocides Regulation) at international, federal and state levels. Contact DEETRegulatory@Vertellus.com with any questions.

HMIS:

NFPA:



15.2. Chemical safety assessment

Not applicable.

SECTION 16: Other information

Full text of R phrases in Section 3:

R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R36/38: Irritating to eyes and skin.
R22: Harmful if swallowed.

Key Data Sources:

- [DEET CAR 2010] Directive 98/8/EC concerning the placing biocidal products on the market, Inclusion of active substances in Annex I or IA to Directive 98/8/EC, Assessment Report, N,N- diethyl-meta-toluamide (DEET) Product-type 19 (Repellents and attractants), 11 March 2010.
- [Desjardins 2002] Desjardins, D, Kendall, T, and Krueger, H (2002) DEET: A 96-Hour Toxicity Test with the Freshwater Alga (*Selenastrum capricornutum*). Wildlife International, Ltd., Project No. 538A-102 (unpublished).
- [Forbis 1985] Forbis, AD and Burgess, D (1985) Acute Toxicity of N,N-Diethyl-Meta-Toluamide (DEET) to *Daphnia magna*. Analytical Bio-Chemistry Laboratories, Inc., Report No. 33909 (unpublished).
- [Grimes 1989] Grimes, J and Jaber, M (1989) An Evaluation of DEET in an Acute Oral Toxicity Study with the Bobwhite. Wildlife International Ltd., Project No. 262-101 (unpublished).
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- [Moore 2000a] Moore, GE (2000) Acute Oral Toxicity with DEET Insect Repellent. Product Safety Labs, Project No. 8392 (unpublished).
- [Moore 2000b] Moore, GE (2000) Acute Inhalation Toxicity Test with DEET Insect Repellent. Product Safety Labs, Project No. 8394 (unpublished).
- [Moore 2000c] Moore, GE (2000) Primary Skin Irritation Test with DEET Insect Repellent. Product Safety Labs, Project No. 8396 (unpublished).

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- [Moore 2001a] Moore, GE (2001) Acute Dermal Toxicity Study - Limit Test with N, N-Diethyl-m-toluamide. Product Safety Labs, Project No. 10883 (unpublished).
- [Moore 2001b] Moore, GE (2001) Primary Eye Irritation Study in Rabbits with N,N-Diethyl-m-toluamide. Product Safety Labs, Project No. 10885 (unpublished).
- [Moore 2001c] Moore, GE (2001) Dermal Sensitization Study in Guinea Pigs (Buehler Method) with N,N-Diethyl-m-toluamide Product Safety Labs, Project No. 10887 (unpublished).
- [Palmer 2002] Palmer, SJ, Kendall, TZ and Krueger, HO (2002) A 96-Hour Static Acute Toxicity Test with the Rainbow Trout (*Oncorhynchus mykiss*). Wildlife International, Ltd., Project No. 538A-101 (unpublished) [Ref. No. 100049].
- [Schaefer 2002] Schaefer, EC and Siddiqui, AI (2002) Ready Biodegradability by the Carbon Dioxide Evolution Test Method. Wildlife International, Ltd., Project No. 538E-102 (unpublished).

Classification Method: On basis of test data

Legend of Abbreviations:

ACGIH = American Conference on Governmental Industrial Hygienists.
CAS = Chemical Abstracts Service.
CFR = Code of Federal Regulations.
DSL/NDSL = Domestic Substances List/Non-Domestic Substances List.
EC = European Community.
EINECS = European Inventory of Existing Commercial Chemical Substances.
ELINCS = European List of Notified Chemical Substances.
EU = European Union.
GHS = Globally Harmonized System.
LC = Lethal Concentration.
LD = Lethal Dose.
NFPA = National Fire Protection Association.
NIOSH = National Institute of Occupational Safety and Health.
NTP = National Toxicology Program.
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Limit.
RQ = Reportable Quantity.
SARA = Superfund Amendments and Reauthorization Act of 1986.
TLV = Threshold Limit Value.
WHMIS = Workplace Hazardous Materials Information System.

Important Note: Please note that the information contained herein is furnished without warranty of any kind. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. The information contained herein may change without prior notice. THIS SAFETY DATA SHEET SUPERSEDES ALL PREVIOUS EDITIONS.

Revision Date:	18 Aug 2014	Original Date of Issue:	No data available.
Issued by:	Regulatory Management Department	Email:	SDS@Vertellus.com
Revision Details:	Revised format		

SAFETY DATA SHEET
Kidde 90 Multi-Purpose ABC Dry Chemical (Fire Extinguishing Agent, Pressurized and Non-pressurized)

1. IDENTIFICATION

Product Name	Kidde 90 Multi-Purpose ABC Dry Chemical (Fire Extinguishing Agent, Pressurized and Non-pressurized)
Other Names	ABC, Ammonium Phosphate, Monoammonium Phosphate, Tri-Class
Recommended use of the chemical and restrictions on use	
Identified uses	Fire Extinguishing Agent
Restrictions on use	Consult applicable fire protection codes
Company Identification	Kidde Residential & Commercial 1016 Corporate Park Drive Mebane, NC 27302 USA
Customer Information Number	(919) 563-5911 (919) 304-8200
Emergency Telephone Number	
CHEMTREC Number	(800) 424-9300 (703) 527-3887 (International)
Issue Date	October 1, 2015
Supersedes Date	April 10, 2015

Safety Data Sheet prepared in accordance with OSHA's Hazard Communication Standard (29 CFR 1910.1200) and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

2. HAZARD IDENTIFICATION

This SDS covers the product listed above as sold in pressurized and non-pressurized containers. GHS classifications for both forms are listed below.

<u>GHS Classification – Pressurized</u>

Hazard Classification
Gas under pressure – Compressed gas

Label Elements
Hazard Symbols

Signal Word: Warning

Hazard Statements
Contents under pressure; may explode if heated.

2. HAZARD IDENTIFICATION

Precautionary Statements
Prevention
None
Response
None
Storage
Protect from sunlight.
Store in well-ventilated place.
Disposal
None

GHS Classification: Non - pressurized

Hazard Classification
This product is classified as not hazardous in accordance with the Globally Harmonized System of Classification and Labelling (GHS).

Label Elements
Hazard Symbols
None

Signal Word: None

Hazard Statements
None

Precautionary Statements

Prevention
None
Response
None
Storage
None
Disposal
None

Other Hazards

Mica may contain small quantities of quartz (crystalline silica) as an impurity. Prolonged exposure to respirable crystalline silica dust at concentrations exceeding the occupational exposure limits may increase the risk of developing a disabling lung disease known as silicosis. IARC found limited evidence for pulmonary carcinogenicity of crystalline silica in humans.

Specific Concentration Limits

The values listed below represent the percentages of ingredients of unknown toxicity.

Acute oral toxicity	< 10%
Acute dermal toxicity	< 10%
Acute inhalation toxicity	< 10%
Acute aquatic toxicity	< 10%

3. COMPOSITION/INFORMATION ON INGREDIENTS

This product is a mixture.

Component	CAS Number	Concentration
Monoammonium Phosphate	7722-76-1	85 - 95%
Ammonium Sulfate	7783-20-2	< 5%
Mica	12001-26-2	< 5%
Clay	1332-58-7	< 5%
Amorphous Silica	7631-86-9	< 5%
Dye	NA	<1%

Note: Pressurized product uses nitrogen or compressed air as the expellant.

4. FIRST- AID MEASURES

Description of necessary first-aid measures

Eyes

Immediately flood the eye with plenty of water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

Skin

Wash skin thoroughly with soap and water. Obtain medical attention if irritation persists.

Ingestion

Dilute by drinking large quantities of water and obtain medical attention.

Inhalation

Move victim to fresh air. Obtain medical attention immediately for any breathing difficulty.

Most important symptoms/effects, acute and delayed

Aside from the information found under Description of necessary first aid measures (above) and Indication of immediate medical attention and special treatment needed, no additional symptoms and effects are anticipated.

Indication of immediate medical attention and special treatment needed

Notes to Physicians

Treat symptomatically.

5. FIRE - FIGHTING MEASURES

Suitable Extinguishing Media

This preparation is used as an extinguishing agent and therefore is not a problem when trying to control a fire. Use extinguishing agent appropriate to other materials involved. Keep pressurized containers and surroundings cool with water spray as they may rupture or burst in the heat of a fire.

Specific hazards arising from the chemical

Pressurized containers may explode in heat of fire.

Special Protective Actions for Fire-Fighters

Wear full protective clothing and self-contained breathing apparatus as appropriate for specific fire conditions.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Wear appropriate protective clothing. Prevent skin and eye contact. Remove leaking container to a safe place. Ventilate the area.

Environmental Precautions
Prevent large quantities of the material from entering drains or watercourses.

Methods and materials for containment and cleaning up
Sweep up or vacuum and transfer into suitable containers for recovery or disposal.

7. HANDLING AND STORAGE

Precautions for safe handling
Wear appropriate protective clothing. Prevent skin and eye contact.

Conditions for safe storage
Pressurized containers should be properly stored and secured to prevent falling or being knocked over. Do not drag, slide or roll pressurized containers. Do not drop pressurized containers or permit them to strike against each other. Never apply flame or localized heat directly to any part of the pressurized or plastic container. Store pressurized and plastic containers away from high heat sources. Storage area should be: - cool - dry - well ventilated - under cover - out of direct sunlight

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
Exposure limits are listed below, if they exist.

Mica
ACGIH TLV: 3 mg/m^3 TWA, measured as respirable fraction of the aerosol.
OSHA PEL**:** 20 mppcf, <1% crystalline silica
Clay as Kaolin, Respirable Fraction
ACGIH TLV: 2 mg/m^3 TWA
OSHA PEL: 15 mg/m^3 TWA, total dust
5 mg/m^3 TWA, respirable fraction
Nuisance Dust Limit
OSHA PEL: 50 mppcf or 15 mg/m^3 TWA, total dust
15 mppcf or 5 mg/m^3 TWA, respirable fraction

Appropriate engineering controls
Use with adequate ventilation. If this product is used in a pressurized system, there should be local procedures for the selection, training, inspection and maintenance of this equipment. When used in large volumes, use local exhaust ventilation.

Individual protection measures
Respiratory Protection
Not normally required. Use dust mask where dustiness is prevalent, or TLV is exceeded. In oxygen deficient atmospheres, use a self contained breathing apparatus, as an air purifying respirator will not provide protection.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Skin Protection
Gloves
Eye/Face Protection
Chemical goggles or safety glasses with side shields.
Body Protection
Normal work wear.

9. PHYSICAL AND CHEMICAL PROPERTIES

Non- Pressurized
Appearance

Physical State	Solid (powder)
Color	Pale Yellow
Odor	Odorless
Odor Threshold	No data available
pH	Not applicable
Specific Gravity	No data available
Boiling Range/Point (°C/F)	Not applicable
Melting Point (°C/F)	No data available
Flash Point (PMCC) (°C/F)	Not flammable
Vapor Pressure	No data available
Evaporation Rate (BuAc=1)	No data available
Solubility in Water	No data available
Vapor Density (Air = 1)	Not applicable
VOC (g/l)	None
VOC (%)	None
Partition coefficient (n-octanol/water)	No data available
Viscosity	No data available
Auto-ignition Temperature	No data available
Decomposition Temperature	No data available
Upper explosive limit	No data available
Lower explosive limit	No data available
Flammability (solid, gas)	No data available

Expellant - Nitrogen
Appearance

Physical State	Compressed gas
Color	Colorless
Odor	None
Odor Threshold	No data available
pH	Not applicable
Specific Gravity	0.075 lb/ft^3 @70^{o}F as vapor
Boiling Range/Point (°C/F)	-196^{o}C/-321 ^{o}F
Melting Point (°C/F)	No data available
Flash Point (PMCC) (°C/F)	Not flammable
Vapor Pressure	No data available
Evaporation Rate (BuAc=1)	No data available
Solubility in Water	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Density (Air = 1)	Not applicable
VOC (g/l)	None
VOC (%)	None
Partition coefficient (n-octanol/water)	No data available
Viscosity	Not applicable
Auto-ignition Temperature	No data available
Decomposition Temperature	No data available
Upper explosive limit	Not explosive
Lower explosive limit	Not explosive
Flammability (solid, gas)	Not flammable

10. STABILITY AND REACTIVITY

Reactivity
Pressurized containers may rupture or explode if exposed to heat.

Chemical Stability
Stable under normal conditions.

Possibility of hazardous reactions
Hazardous polymerization will not occur.

Conditions to Avoid
Exposure to direct sunlight - contact with incompatible materials

Incompatible Materials
Strong oxidizing agents - strong acids - sodium hypochlorite

Hazardous Decomposition Products
Oxides of carbon - ammonia - oxides of phosphorus - nitrogen oxides

11. TOXICOLOGICAL INFORMATION

Acute Toxicity
Monoammonium Phosphate:
Oral LD50 (Rat) 5750 mg/kg
Dermal LD50 (Rabbit) >5000mg/kg
Inhalation LC50 (Rat) 5.1mg/l
Ammonium Sulfate:
Oral LD50 (Rat) 4250 mg/kg
Dermal LD50 (Rabbit) >2000mg/kg
Mica:
Oral LD50 (Rat) >2000 mg/kg
Amorphous Silica:
Oral LD50 (Rat) >5000 mg/kg
Dermal LD50 (Rabbit) >2000mg/kg

11. TOXICOLOGICAL INFORMATION

Clay:
Oral LD50 (Rat) >5000 mg/kg
Dermal LD50 (Rabbit) >5000mg/kg
Nitrogen
Simple asphyxiant

Specific Target Organ Toxicity (STOT) – single exposure
Monoammonium Phosphate: Available data indicates this component is not expected to cause target organ effects after a single exposure.
Ammonium Sulfate: Available data indicates this component is not expected to cause target organ effects after a single exposure.
Nitrogen: Exposure to nitrogen gas at high concentrations can cause suffocation by reducing oxygen available for breathing. Breathing very high concentrations can cause dizziness, shortness of breath, unconsciousness or asphyxiation.

Specific Target Organ Toxicity (STOT) – repeat exposure
Monoammonium Phosphate: Available data indicates this component is not expected to cause target organ effects after repeat exposure.
Ammonium Sulfate: Available data indicates this component is not expected to cause target organ effects after repeat exposure.

Serious Eye damage/Irritation
Monoammonium Phosphate: Not irritating (rabbit)
Ammonium Sulfate: Not irritating (rabbit)
Mica: Not irritating (rabbit)

Skin Corrosion/Irritation
Monoammonium Phosphate: Not irritating in rabbit test study
Ammonium Sulfate: Not irritating (rabbit)
Mica: Not irritating (rabbit)

Respiratory or Skin Sensitization
Monoammonium Phosphate: Not skin sensitizing based on test (Mouse local lymphnode assay (LLNA)) on an analogous compound
Ammonium Sulfate: Not sensitizing in Guinea pig maximisation test

Carcinogenicity
Mica may contain small quantities of quartz (crystalline silica) as an impurity. Prolonged exposure to respirable crystalline silica dust at concentrations exceeding the occupational exposure limits may increase the risk of developing a disabling lung disease known as silicosis. IARC has classified Silica Dust, Crystalline, in the form of quartz or cristobalite as 1 (carcinogenic to humans).

Germ Cell Mutagenicity
Monoammonium Phosphate: Not mutagenic in the mouse lymphoma cells in mammalian cell gene mutation assay
Ammonium Sulfate: Negative results in Ames Test, in vitro mammalian chromosome aberration test, and mammalian cell gene mutation assay.

11. TOXICOLOGICAL INFORMATION

Reproductive Toxicity
Monoammonium Phosphate: Available data indicates this component is not expected to cause reproductive toxicity or birth defects.
Ammonium Sulfate: Available data indicates this component is not expected to cause reproductive toxicity or birth defects.

Aspiration Hazard
Not an aspiration hazard.

12. ECOLOGICAL INFORMATION

Ecotoxicity
Monoammonium Phosphate:
LC50 rainbow trout >100 mg/l 96h
LC50 water flea 1790 mg/l 72h (similar substance)

Mobility in soil
No relevant studies identified.

Persistence/Degradability
No relevant studies identified.

Bioaccumulative Potential
No relevant studies identified.

Other adverse effects
No relevant studies identified.

13. DISPOSAL CONSIDERATIONS

Disposal Methods
Dispose of container in accordance with all applicable local and national regulations.

14. TRANSPORT INFORMATION

Safety Data Sheet information is intended to address a specific material and not various forms or states of containment.

Special Precautions for Shipping:
Individuals must be certified as Hazardous Material Shipper for all transportation modes.
Pressurized Fire Extinguishers are considered a hazardous material by the US Department of Transportation and Transport Canada.

DOT CFR 172.101 Data	Fire extinguishers, 2.2, UN1044
UN Proper Shipping Name	Fire extinguishers
UN Class	(2.2)
UN Number	UN1044
UN Packaging Group	Not applicable

14. TRANSPORT INFORMATION

Classification for AIR Transportation (IATA)	Consult current IATA Regulations prior to shipping by air.
Classification for Water Transport IMDG	Consult current IMDG Regulations prior to shipping by water.

When shipping via ground, portable fire extinguishers pressurized to less than 241 psi and of less than 1100 cubic inches in size meet the requirements of “Limited Quantity” as referenced in 49 CFR 173.309 (2010). There is no limited quantity designation for fire extinguishers when shipped by air or water.

This section is believed to be accurate at the time of preparation. It is not intended to be a complete statement or summary of the applicable laws, rules, or hazardous material regulations, and is subject to change. Users have the responsibility to confirm compliance with all laws, rules, and hazardous material regulations in effect at the time of shipping.

15. REGULATORY INFORMATION

United States TSCA Inventory
This product contains ingredients that are listed on or exempt from listing on the EPA Toxic Substance Control Act Chemical Substance Inventory.

Canada DSL Inventory
All ingredients in this product are listed on the Domestic Substance List (DSL) or the Non-Domestic Substance List (NDSL) or are exempt from listing.

SARA Title III Sect. 311/312 Categorization: Pressurized
Pressure hazard
SARA Title III Sect. 311/312 Categorization: Non-pressurized
None

SARA Title III Sect. 313
This product does not contain any chemicals that are listed in Section 313 at or above de minimis concentrations.

16. OTHER INFORMATION

NFPA Ratings
NFPA Code for Health - 1
NFPA Code for Flammability - 0
NFPA Code for Reactivity - 0
NFPA Code for Special Hazards - None

HMIS Ratings
HMIS Code for Health - 1
HMIS Code for Flammability - 0
HMIS Code for Physical Hazard - 0
HMIS Code for Personal Protection - See Section 8
*Chronic

16. OTHER INFORMATION

Legend
ACGIH: American Conference of Governmental Industrial Hygienists
CAS#: Chemical Abstracts Service Number
EC50: Effect Concentration 50%
IARC: International Agency for Research on Cancer
LC50: Lethal Concentration 50%
LD50: Lethal Dose 50%
N/A: Denotes no applicable information found or available
OSHA: Occupational Safety and Health Administration
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit
TLV: Threshold Limit Value
TSCA: Toxic Substance Control Act

Revision Date: October 1, 2015
Replaces: April 10, 2015
Changes made: Update to Section 14.

Information Source and References
This SDS is prepared by Hazard Communication Specialists based on information provided by internal company references.
Prepared By: EnviroNet LLC.

The information and recommendations presented in this SDS are based on sources believed to be accurate. Kidde Residential & Commercial assumes no liability for the accuracy or completeness of this information. It is the user's responsibility to determine the suitability of the material for their particular purposes. In particular, we make NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, with respect to such information, and we assume no liability resulting from its use. Users should ensure that any use or disposal of the material is in accordance with applicable Federal, State, and local laws and regulations.

1 Identification

· ***Product identifier***

· ***Trade name:*** *SUN X SPF 30+ BROAD SPECTRUM SUNCREEN LOTION*

· ***Details of the supplier of the safety data sheet***

· ***Manufacturer/Supplier:***

CoreTex Products, Inc.
1850 Sunnyside Ct.
Bakersfield, CA 93308
skincare@coretexproducts.com

· ***Information department:*** *Product safety department*

· ***Emergency telephone number:*** *CHEMTEL - 1.800.255.3924 - 24 HOURS*

2 Hazard(s) identification

· ***Classification of the substance or mixture***

The product is not classified according to the Globally Harmonized System (GHS).

· ***Classification according to Directive 67/548/EEC or Directive 1999/45/EC*** *Not applicable.*

· ***Information concerning particular hazards for human and environment:***

The product does not have to be labeled due to the calculation procedure of international guidelines.

· ***Classification system:***

The classification was made according to the latest editions of international substances lists, and expanded upon from company and literature data.

· ***Label elements***

· ***Labelling according to EU guidelines:***

Observe the general safety regulations when handling chemicals.

The product is not subject to identification regulations according to directives on hazardous materials.

· ***Classification system:***

· ***NFPA ratings (scale 0 - 4)***

Health = 0
Fire = 0
Reactivity = 0

· ***HMIS-ratings (scale 0 - 4)***

Health = 0
Fire = 0
Reactivity = 0

· ***Other hazards***

· ***Results of PBT and vPvB assessment***

· ***PBT:*** *Not applicable.*

· ***vPvB:*** *Not applicable.*

3 Composition/information on ingredients

· ***Chemical characterization: Mixtures***

· ***Description:*** *Mixture of the substances listed below with nonhazardous additions.*

4 First-aid measures

· **Description of first aid measures**
· **General information:** No special measures required.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:** Product may irritate sensitive skin.
· **After eye contact:** Rinse opened eye for several minutes under running water.
· **After swallowing:** If symptoms persist consult doctor.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
CO_2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** Dilute with plenty of water.
· **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
· **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· **Handling:**
· **Precautions for safe handling** No special measures required.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:** Store at room temperature and out of direct sun.
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** None.
· **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

· **Control parameters**
· **Components with limit values that require monitoring at the workplace:**
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
· **Breathing equipment:** Not required.
· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:** Goggles recommended during refilling.

9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**

· **Appearance:**	
Form:	Viscous
Color:	Whitish
· **Odor:**	Characteristic
· **Odor threshold:**	Not determined.
· **pH-value at 20 °C (68 °F):**	5.4
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	100 °C (212 °F)
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not applicable.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure at 20 °C (68 °F):**	23 hPa (17 mm Hg)

· **Density:**	Not determined.
· **Relative density**	Not determined.
· **Vapour density**	Not determined.
· **Evaporation rate**	Not determined.
· **Solubility in / Miscibility with**	
Water:	Fully miscible.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not determined.
Kinematic at 20 °C (68 °F):	37000 cstk (DIN 53211/4)
· **Solvent content:**	
Organic solvents:	0.9 %
Water:	67.6 %
VOC content:	0.9 %
	13.0 g/l / 0.11 lb/gl
Solids content:	31.5 %
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity**
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **on the skin:** No irritant effect.
· **on the eye:** No irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product is not subject to classification according to internally approved calculation methods for preparations:
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.

· **Behavior in environmental systems:**
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:** Generally not hazardous for water
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:** Smaller quantities can be disposed of with household waste.

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agent:** Water, if necessary with cleansing agents.

14 Transport information

· **UN-Number** · **DOT, ADN, IMDG, IATA**	Void
· **UN proper shipping name** · **DOT, ADN, IMDG, IATA**	Void
· **Transport hazard class(es)** · **DOT, ADN, IMDG, IATA** · **Class**	Void
· **Packing group** · **DOT, IMDG, IATA**	Void
· **Environmental hazards:** · **Marine pollutant:**	No
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	-

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**
None of the ingredients is listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

· **Product related hazard informations:**
Observe the general safety regulations when handling chemicals.
The product is not subject to identification regulations according to directives on hazardous materials.

· **Chemical safety assessment:** *A Chemical Safety Assessment has not been carried out.*

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
VOC: Volatile Organic Compounds (USA, EU)

Appendix G

Marine Safety

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Float Plan

Iona Island MMRP Survey, Iona Island New York, Vessel Float Plan
EA Project # 63029587

Filed by: VESSEL CAPTAIN, DATE

DRAFT – FINAL FLOAT PLAN TO BE FILED BY FIELD CREW PRIOR TO MOBILIZATION

Vessel will be inspected by U.S. Coast Guard Auxiliary Personnel prior to Mobilization and documentation of inspection attached to final Float Plan.

All vessel operations will be conducting according to EA's Corporate Vessel Operations Manual (Appendix G) and follow EA's Standard Operating Procedures for Small Boat Operations (Appendix G).

Vessel Specs: VESSEL NAME

Registration: VESSEL REGISTRATION

Propulsion: VESSEL PROPULSION

Launch Location: Haverstraw Bay Park Boat Ramp, 21 Gagan Road, Haverstraw, NY 10927

Safety Equipment: 3 Fire extinguishers, flare gun, horn, safety whistle, USCG Type IV Throwable life ring, USCG Type III life jackets, USCG Type I life jackets

Personnel on board: To Be Determined

Cell Phones: To Be Determined

Allergies: To Be Determined

Sampling Type: Magnetometer Survey and UXO Diving Operations

Operational Area: Hudson River, Nearshore areas on the eastern side of Iona Island, NY. See Attached Figure 1-1.

Onshore Contacts: Site Project Manager / Site Supervisor or other designated site contact.

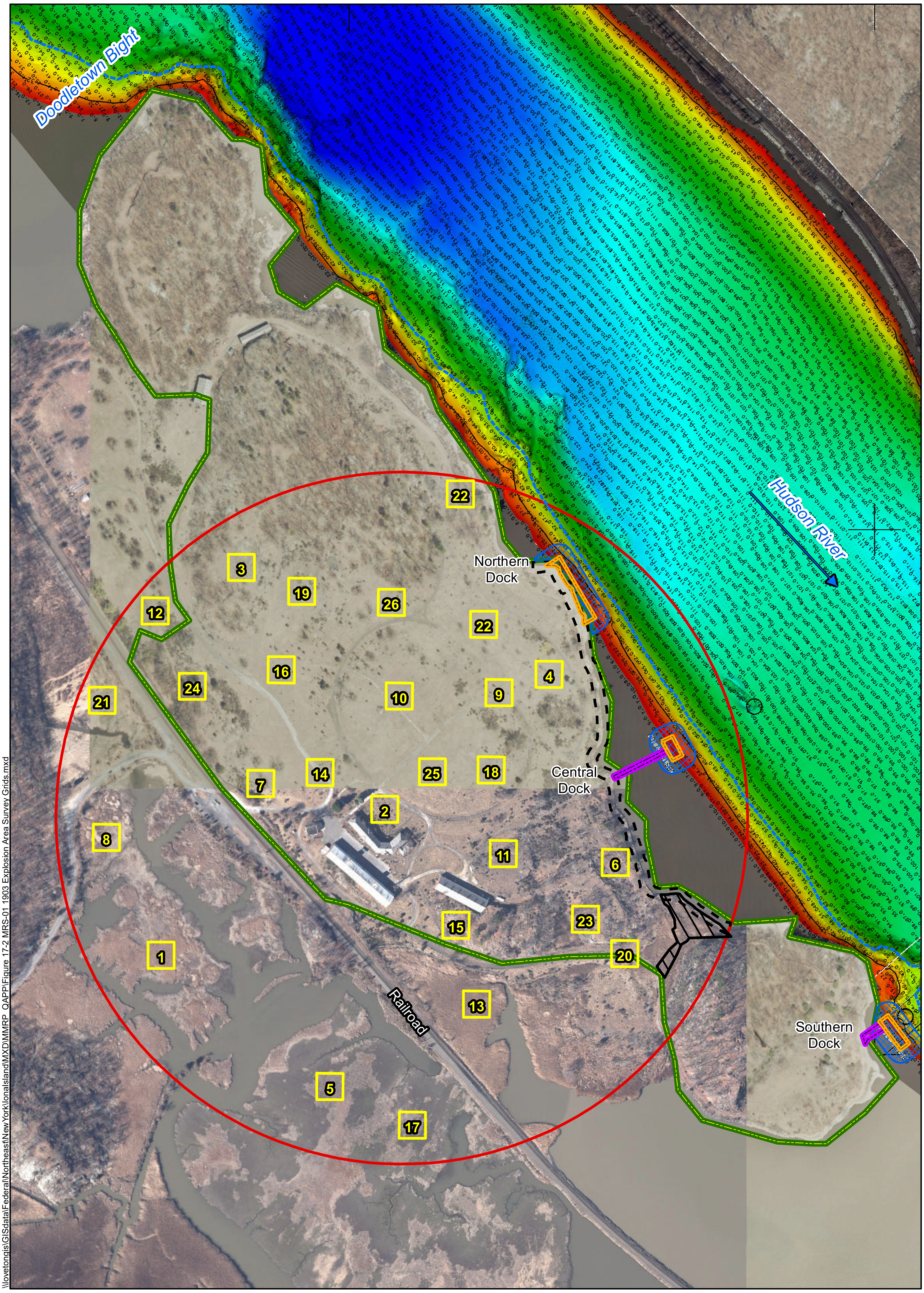
Emergency Contacts: U.S. Coast Guard Station, Sector New York (718) 354-4037;
VHF Channel 16;
Police, Fire, EMS: 911

Severe Weather Plan

If no severe weather events are predicted during the survey period, EA personnel will monitor Doppler Radar at least once every three (3) hours. If severe weather is predicted, the interval will be reduced to no less than once every hour. In the event of severe weather, while operating at Iona Island EA personnel will depart the site location at least 1.5 hours before the storm is predicted to reach the work site, transiting south to a safe harbor at the Haverstraw Bay Park Boat Ramp.

Shore Contacting Schedule

Prior to departure from the mobilization site, EA vessel personnel will contact the designated shore contact, detailing the specific survey location(s) and activities as well expected return to shore time. Upon return to shore, vessel personnel will call the shore contact and provide a daily report and disclose any incidents. In the event that vessel personnel do not call the shore contact within one (1) hour of scheduled arrival time, the shore contact will attempt to call vessel personnel via cell phone. If no vessel personnel can be reached, the shore contact will call the U.S. Coast Guard Station Sector New York at (718) 354-4037 to make the station aware that the survey crew and vessel is overdue to the dock.



0 450 900
Feet

N

Legend

- Approximate 60 Foot Depth Line
- DGM Grid (100ft x 100ft)
- Underwater Investigation Area (Former Docks)
- DGM Shoreline Area
- Dump SIte
- Former Dock
- Former Causeway
- FUDS Boundary
- MRS-01 1903 Explosion Area

Note:
Dives will be limited to 3-60 ft or where the river bottom is less then 20 degree slope or determined acceptable by Direct Person in Charge.
Transects in water depth less then 3 ft will be walked.

FIGURE 17-2
MRS-01 1903 EXPLOSION AREA SURVEY GRIDS

IONA ISLAND NAVAL AMMUNITION DEPOT
FORMERLY USED DEFENSE SITE
ROCKLAND COUNTY, NY

Map Date: 10/03/2018
Dock Aerial - June 18 1948

Corporate Vessel Operations Manual

EA Engineering, Science, and Technology, Inc.

Corporate Vessel Operations Manual

December 2004

CONTENTS

NOTE: Prior to beginning any EA vessel-related activities, copies of the checklists (Chapter 11) should be made available for easy access.

Page

LIST OF TABLES

1. INTRODUCTION

Personnel involved in activities associated with boating and watercraft are potentially exposed to a variety of hazards from activities including operations, maintenance, and transportation.

No person will be required or instructed to work in surroundings or under conditions that are unsafe or dangerous to his or her health.

Each individual employee is responsible for complying with applicable safety requirements, wearing prescribed safety equipment, and preventing avoidable accidents.

Safety and health programs, documents, signs, and tags will be communicated to employees in a language that they understand.

Adequate planning is needed before performing work at these sites to reduce the risk of employee injury or illness.

A partial listing of terms and phrases used during the operation of a vessel is provided in Appendix A. All members of the crew should be familiar with these terms.

1.1 PURPOSE

The purpose of this Manual is to communicate EA's basic policies and procedures regarding safety and health during the performance of work involving boating and watercraft activities. This Manual introduces the reader to EA's Boating and Watercraft Operations Program and critical references and definitions of terms used in this program.

1.2 APPLICABILITY

The procedures and requirements in this section apply to EA and subcontractor personnel involved in the boating and watercraft activities and operations. Visitors are required to follow these requirements.

1.3 DISCLAIMER

This Manual is not a comprehensive overview of all situations an operator may encounter, is not a substitute for common sense or experience, nor is it a substitute for a project- and/or site-specific Safety and Health Plan, as applicable.

1.4 REFERENCES

Maloney, E.S. 1981. Chapman Piloting, Seamanship and Small Boat Handling, 55th Edition. The Hearst Corporation, New York.

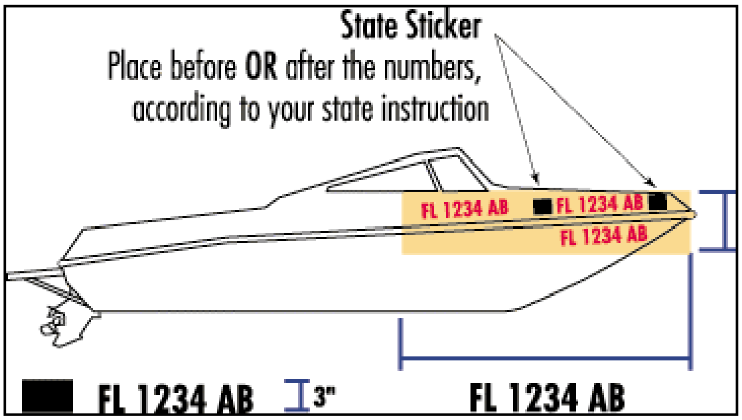
U.S. Coast Guard safe boating website: www.uscgboating.org.

2. BOATING LAWS AND REGULATIONS

The purpose of this section is to acquaint the reader with different types of vessel registrations and numbering, according to the Federal Boat Safety Act of 1971, and adopted by Congress 15 July 1997.

2.1 REGISTRATION, NUMBERING, AND DOCUMENTATION

All undocumented vessels equipped with propulsion machinery must be registered in the state of principal use. A Certificate of Number will be issued upon registering the vessel. These numbers must be displayed on your vessel. The owner/operator of a vessel must carry a valid Certificate of Number whenever the vessel is in use. When moved to a new state of principal use, the certificate is valid for 60 days. Check with your state boating authority for numbering requirements. Some states require all vessels to be numbered.



Some larger recreational vessels may be documented. The certificate of documentation MUST be on board a documented vessel at all times. A document serves as a certificate of nationality and an authorization for a specific trade. A documented vessel is not exempt from applicable state or federal taxes, nor is its operator exempt from compliance with federal or state equipment carriage requirements.

2.1.1 Display of Numbers

Numbers must be painted or permanently attached to each side of the forward half of the vessel. The validation stickers must be affixed within 6 in. of the registration number. With the exception of the vessel fee decal, no other letters or numbers may be displayed nearby.

2.1.2 Notification of Changes to a Numbered Vessel

The owner of a vessel must notify the agency that issued the Certificate of Number within 15 days if:

- The vessel is transferred, destroyed, abandoned, lost, stolen, or recovered
- The Certificate of Number is lost or destroyed, or the owner's address changes.

If the Certificate of Number becomes invalid for any reason, it must be surrendered in the manner prescribed to the issuing authority within 15 days.

A documented vessel must have the name of the vessel and hailing port plainly marked on the exterior part of the hull in clearly legible letters not less than 4 in. in height. In addition, the documented vessel must have the "Official Number" permanently affixed in block type, Arabic numerals, not less than 3 in. in height on some clearly visible interior structural part of the boat.

Table 2-1 provides a quick reference of vessel length and equipment requirements. The "Rules of the Water" are provided in Appendix B.

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TABLE 2-1 QUICK REFERENCE

Vessel Length (in ft)				Equipment	Requirement
<16	16<26	26<40	40<65		
X	X	X	X	Certificate of Number (State Registration)	All undocumented vessels equipped with propulsion machinery must be State registered. Certificate of Number must be on board when vessel is in use. NOTE: Some states require all vessels to be numbered.
X	X	X	X	State Numbering	(a) Plain block letters/numbers not less than 3 in. in height must be affixed on each side of the forward half of the vessel (Contrasting color to boat exterior). (b) State validation sticker must be affixed within 6 in. of the registration number.
	X	X	X	Certificate of Documentation	Applies only to "Documented" vessels: (a) Original and current certificate must be on board. (b) Vessel name/hailing port marked on exterior part of hull - letters not less than 4 in. in height. (c) Official Number permanently affixed to interior structure - numbers not less than 3 in. in height.
X	X	X	X	Life Jackets (personal flotation devices)	(a) One Type I, II, III, or V wearable personal flotation device for each person on board (must be U.S. Coast Guard approved).
	X	X	X		(b) In addition to Paragraph (a), must carry One Type IV (throwable) personal flotation device.
X				Visual Distress Signal	(a) One electric distress light or Three combination (day/night) red flares. NOTE: Only required to be carried on board when operating between sunset and sunrise.
	X	X	X		(b) One orange distress flag or one electric distress light; or three hand-held or floating orange smoke signals and one electric distress light; or three combination (day/night) red flares: hand-held, meteor, or parachute type.
X	X			Fire Extinguishers	(a) One B-I (when enclosed compartment).
		X			(b) One B-II or two B-I. NOTE: Fixed system equals one B-I.
			X		(c) One B-II and one B-I or three B-I. NOTE: Fixed system equals one B-I.
X	X	X	X	Ventilation	(a) All vessels built after 25 April 1940 that use gasoline as their fuel with enclosed engine and/or fuel tank compartments must have natural ventilation (at least two ducts fitted with cowls). (b) In addition to paragraph (a), a vessel built after 31 July 1980 must have rated power exhaust blower.
X	X	X	X	Backfire Flame Arrester	Required on gasoline engines installed after 25 April 1940, except outboard motors.
X	X	X	X	Sound Producing Devices	(a) Some means of making an "efficient" sound signal—audible for 1/2 mi/4-6 seconds (i.e., horn)
		X	X		(b) In addition to Paragraph (a), a vessel 39.4 ft (12 m) or greater, must carry on board a bell with clapper (bell size not less than 7.9 in.—based on the diameter of the mouth).
X	X	X	X	Navigational Lights	Required to be displayed from sunset to sunrise and in or near areas of reduced visibility.
NA	NA	NA	NA	FCC Radio License	Operator of a recreational vessel less than 65.6 ft (20 m) in length is not required to be licensed to operate VHF marine radios, emergency position indicating radio beacons, or any type of radar.
		X	X	Oil Pollution Placard	(a) Placard must be at least 5 × 8 in., made of durable material. (b) Placard must be posted in the machinery space or at the bilge station.
		X	X	Garbage Placard	(a) Placard must be at least 4 × 9 in., made of durable material. (b) Displayed in a conspicuous place notifying all on board the discharge restrictions.
X	X	X	X	Marine Sanitation Device	If installed toilet, vessel must have an operable Marine Sanitation Device Type I, II, or III.
		X	X	Navigational Rules (inland only)	The operator of a vessel 39.4 ft (12 m) or greater must have on board a copy of these rules.

NOTE: NA = Not applicable.

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3. FEDERAL MANDATED SAFETY EQUIPMENT

Federal mandated safety equipment is governed by the U.S. Coast Guard (USCG) Motor Boat Act of 1940 and retained by the Federal Boat Safety Act of 1971, which covers four classes of boats. Table 3-1 provides the minimum required equipment.

3.1 EQUIPMENT REQUIREMENTS – PERSONAL FLOTATION DEVICE

The USCG sets minimum safety standards for recreational boats and associated safety equipment. To meet these standards some of the equipment must be USCG approved. “USCG Approved Equipment” meets USCG specifications and regulations relating to performance, construction, or materials.

3.1.1 Personal Flotation Devices

All recreational boats must carry one wearable personal flotation device (PFD) (Type I, II, III, or V) for each person aboard. A Type V PFD provides performance of either a Type I, II, or III PFD (as marked on its label) and must be used according to the label requirements. Any boat 16 ft and longer (except canoes and kayaks) must also carry one throwable PFD (Type IV PFD).

PFDs must be USCG approved, in good and serviceable condition, and the appropriate size for the intended user.

Accessibility

- Wearable PFDs must be readily accessible
- You must be able to put them on in a reasonable amount of time in an emergency (vessel sinking, on fire, etc.)
- They should not be stowed in plastic bags, in locked or closed compartments, or have other gear stowed on top of them
- The best PFD is the one you will wear
- Though not required, a PFD should be worn at all times when the vessel is underway; a wearable PFD may save your life, but only if you wear it
- Throwable devices must be immediately available for use.

Inflatable Personal Flotation Devices

- Inflatable PFDs may be more comfortable to wear
- The best PFD is the one you will wear
- Inflatable PFDs require the user to pay careful attention to the condition of the device.
- Inflatable PFDs must have a full cylinder and all status indicators on the inflator must be green, or the device is NOT serviceable, and does NOT satisfy the requirement to carry PFDs.

USCG-approved inflatable PFDs are authorized only on recreational boats by a person at least 16 years of age.

Personal Flotation Device Requirements for Certain Boating Activities under State Laws

The USCG recommends, and many states require, wearing PFDs for the following activities:

- Water skiing and other towed activities (use a PFD marked for water skiing)
- While operating personal watercraft (use a PFD marked for water skiing or personal watercraft use)
- During white water boating activities
- While sailboarding (under federal law, sailboards are not "boats").

Check with your state boating safety officials.

Federal law does not require PFDs on racing shells, rowing sculls, and racing kayaks. State laws vary. Check with your state boating safety officials.

If you are boating in an area under the jurisdiction of the U.S. Army Corps of Engineers, or a federal, state, or local park authority, other rules may apply.

Remember, PFDs will keep you from sinking, but not necessarily from drowning.

- Select a properly-sized PFD to ensure a safe and proper fit
- Test your PFD by wearing it in shallow water or guarded swimming pool to see how it will float you.

U.S. Coast Guard Auxiliary U.S. Power Squadrons Vessel Safety Check Requirements for Personal Flotation Devices

- All boats must be equipped with a wearable PFD for each person on board
- Boats 16 ft and over are required to have a minimum of two PFDs on board, one wearable PFD (Type I, II, III, or V) and one throwable (Type IV); in addition, a wearable PFD is required for each person on board.

Personal Flotation Device Flotation

There are three basic kinds of PFD flotation in the five types of PFDs with the following characteristics:

- **Inherently Buoyant (primarily Foam)**
  - — The *most* reliable
  - — Adult, youth, child, and infant sizes
  - — For swimmers and non-swimmers

— Wearable and throwable styles
— Some designed for water sports

Minimum Buoyancy		
Wearable Size	Type	Inherent Buoyancy (Foam)
Adult	I II and III V	22 lb 15.5 lb 15.5 to 22 lb
Youth	II and III V	11 lb 11 to 15.5 lb
Child and Infant	II	7 lb
Throwable: Cushion Ring Buoy	 IV	 20 lb 16.5 and 32 lb

- **Inflatable**

— The most compact
— Sizes only for adults
— Only recommended for swimmers
— Wearable styles only
— Some with the best in-water performance

Minimum Buoyancy		
Wearable Size	Type	Inherent Buoyancy
Adult	I and II III V	34 lb 22.5 lb 22.5-34 lb

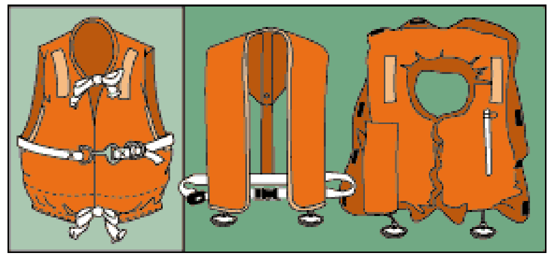
- **Hybrid (Foam and Inflation)**

— Reliable
— Adult, youth, and child sizes
— For swimmers and non-swimmers
— Wearable styles only
— Some designed for water sports

Hybrid (Foam and Inflation)			
Wearable Size	Type	Inherent Buoyancy	Inflated Total Buoyancy
Adult	II and III V	10 lb 7.5 lb	22 lb 22 lb
Youth	II and III V	9 lb 7.5 lb	15 lb 15 lb
Child	II	7 lb	12 lb

Types of Personal Flotation Devices

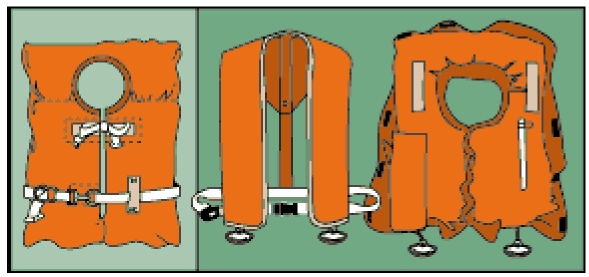
A Type I PFD, or offshore life jacket, provides the most buoyancy. It is effective for all waters, especially open, rough, or remote waters where rescue may be delayed. It is designed to turn most unconscious wearers in the water to a face-up position.



Off-Shore Life Jackets

Inherently Buoyant — Inflatable

A Type II PFD, or near-shore buoyancy vest, is intended for calm, inland water or where there is a good chance of quick rescue. Inherent buoyant PFDs of this type will turn *some* unconscious wearers to a face-up position in the water, but the turning is not as pronounced as a Type I. This type of inflatable turns as well as a Type I foam PFD.



Near-shore Buoyancy Vests

Inherently Buoyant — Inflatable

A Type III PFD, or flotation aid, is good for conscious users in calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water. The wearer may have to tilt their head back to avoid turning face down in the water. The Type III foam vest has the same minimum buoyancy as a Type II PFD. It comes in many styles, colors, and sizes and is generally the most comfortable type for continuous wear. Float coats, fishing vests, and vests designed with features suitable for various sports activities are examples of this type PFD. This type inflatable turns as well as a Type II foam PFD.

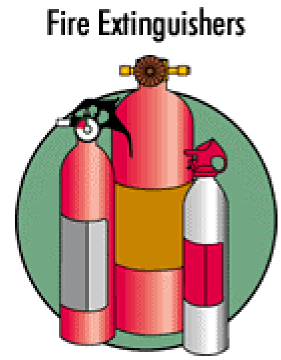
Throwable Devices

A Type IV PFD, or throwable device, is intended for calm, inland water with heavy boat traffic, where help is always present. It is designed to be thrown to a person in the water and grasped and held by the user until rescued—it is *not* designed to be worn. Type IV devices include buoyant cushions, ring buoys, and horseshoe buoys. There are no inflatable Type IV devices.

A Type V PFD, or special use device is intended for specific activities and may be carried instead of another PFD only if used according to the approval condition(s) on its label. A Type V PFD provides performance of either a Type I, II, or III PFD (as marked on its label). If the label says the PFD is "approved only when worn" the PFD must be worn, except for persons in enclosed spaces and used in accordance with the approval label, to meet carriage requirements. Some Type V devices provide significant hypothermia protection. Varieties include deck suits, work vests, and board sailing vests.

3.2 EQUIPMENT REQUIREMENTS – FIRE EXTINGUISHERS

USCG-approved fire extinguishers are required on boats where a fire hazard could be expected from the motors or the fuel system. Extinguishers are classified by a letter and number symbol. The letter indicates the type of fire the unit is designed to extinguish (Type B, for example, are designed to extinguish flammable liquids such as gasoline, oil, and grease fires). The number indicates the relative size of the extinguisher. The higher the number, the larger the extinguisher.



USCG-approved extinguishers required for boats are hand portable, either B-I or B-II classification, and have a specific marine type mounting bracket. The special bracket is required to securely hold the extinguisher in a moving boat. It is recommended the extinguishers be mounted in a readily accessible position, away from the areas where a fire could likely start such as the galley or the engine compartment.

Extinguisher markings can be confusing because extinguishers can be approved for several different types of hazards. For instance, an extinguisher marked “Type A, Size II, Type B:C, Size I” is a B-I extinguisher.

Look for the part of the label that reads “Marine Type USCG.”

- Make sure Type B is indicated
- Portable extinguishers will be either size I or II. Size III and larger are too big for use on most recreational boats.

Classes	Foam (gal)	CO_2 (lb)	Dry Chemical (lb)	Halon (lb)
B-I (Type B, Size I)	1.25	4	2	2.5
B-II (Type B, Size II)	2.5	15	10	10

Fire extinguishers are required on boats if any of the following conditions exist:

- Inboard engines are installed.
- There are closed compartments and compartments under seats where portable fuel tanks may be stored.
- There are double bottoms not sealed to the hull or which are not completely filled with flotation materials.
- There are closed living spaces.
- There are closed stowage compartments in which combustible or flammable materials are stored.
- There are permanently installed fuel tanks (fuel tanks secured so they cannot be moved in case of fire or other emergency are considered permanently installed. There are no gallon capacity limits to determine if a fuel tank is portable. If the weight of a fuel tank is such that persons on board cannot move it, the USCG considers it permanently installed).

3.2.1 Fire Extinguisher Maintenance

Inspect extinguishers monthly to make sure that:

- Seals and tamper indicators are not broken or missing
- Pressure gauges or indicators read in the operable range (NOTE: CO_2 extinguishers do not have gauges)

- There is no obvious physical damage, corrosion, leakage, or clogged nozzles
- Weigh extinguishers annually to assure that the minimum weight is as stated on the extinguisher label.

Fire extinguishers that do not satisfy the above requirements or that have been partially emptied must be replaced or taken to a qualified fire extinguisher servicing company for recharge.

3.2.2 Required Number of Fire Extinguishers

The number of fire extinguishers required on a recreational boat is based on the overall length of the boat. The following chart lists the number of extinguishers that are required. In the case where a USCG-approved pre-engineered fire extinguishing system is installed for the protection of the engine compartment, the required number of units may be reduced in accordance with the chart.

Minimum number of hand portable fire extinguishers required:

Vessel Length	No Fixed System	With Approved Fixed Systems
Less than 26 ft	1 B-1	0
26 ft to less than 40 ft	2 B-1 or 1 B-II	1 B-I
40-65 ft	3 B-I or 1 B-II and 1 B-I	2 B-1 or 1 B-II

The pressure gauge alone is not an accurate indicator that Halon extinguishers are full. The weight of the units should be checked regularly. It is recommended that portable extinguishers be mounted in a readily accessible position.

3.3 EQUIPMENT REQUIREMENTS – VENTILATION

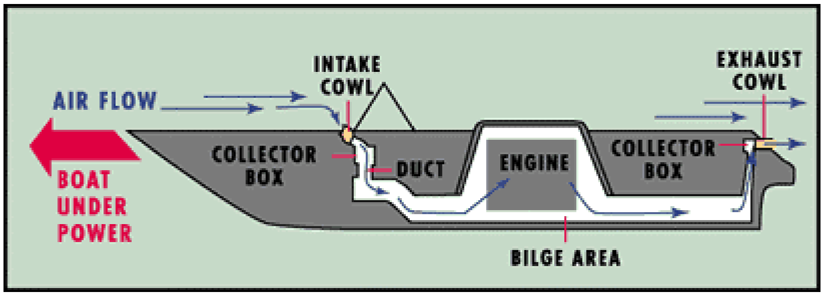
All boats that use gasoline for electrical generation, mechanical power, or propulsion are required to be equipped with a ventilation system. A natural ventilation system is required for each compartment in a boat that:

- Contains a permanently installed gasoline engine
- Has openings between it and a compartment that requires ventilation
- Contains a permanently installed fuel tank and an electrical component that is not ignition-protected
- Contains a fuel tank that vents into that compartment (including a portable tank)
- Contains a non-metallic fuel tank.

A natural ventilation system consists of:

- A supply opening (duct/cowl) from the atmosphere (located on the exterior surface of the boat) or from a ventilated compartment or from a compartment that is open to the atmosphere

- An exhaust opening into another ventilated compartment or an exhaust duct to the atmosphere



All blower motors installed in exhaust ducts must be in working condition of date of manufacture.

Each exhaust opening or exhaust duct must originate in the lower one-third of the compartment. Each supply opening or supply duct and each exhaust opening or duct in a compartment must be above the normal accumulation of bilge water.

A powered ventilation system is required for each compartment in a boat that has a permanently installed gasoline engine with a cranking motor for remote starting.

A powered ventilation system consists of one or more exhaust blowers. Each intake duct for an exhaust blower must be in the lower one-third of the compartment and above the normal accumulation of bilge water.
For boats built prior to 1980, there was no requirement for a powered ventilation system; however, some boats were equipped with a blower.

The USCG Ventilation Standard, a manufacturer requirement, applies to all boats built on or after 1 August 1980. Some builders began manufacturing boats in compliance with the Ventilation Standard as early as August 1978. If your boat was built on or after 1 August 1978, it might have been equipped with either: (1) a natural ventilation system, or (2) both a natural ventilation system and a powered ventilation system. If your boat bears a label containing the words "This boat complies with USCG safety standards," etc., you can assume that the design of your boat's ventilation system meets applicable regulations.

Manufacturers of boats built after 1980 with remote starters are required to display a label that contains the following information:

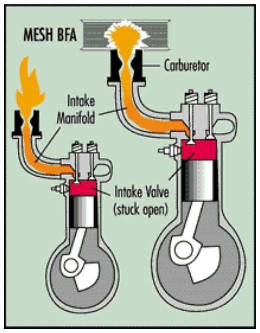
WARNING
Gasoline vapors can explode. Before starting engine, operate blower at least 4 minutes and check engine compartment bilge for gasoline vapors.

All owners of boats equipped with exhaust blowers are strongly encouraged to take the same precautions before starting a gasoline engine.

All owners are responsible for keeping their boat's ventilation systems in operating condition. This means making sure openings are free of obstructions, ducts are not blocked or torn, blowers operate properly, and worn components are replaced with equivalent marine type equipment.

3.4 EQUIPMENT REQUIREMENTS – BACKFIRE FLAME ARRESTOR

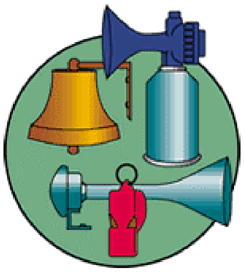
Flame Arrestor



Gasoline engines installed in a vessel after 25 April 1940, except outboard motors, must be equipped with an acceptable means of backfire flame control. The device must be suitably attached to the air intake with a flame tight connection and is required to be USCG approved or comply with SAE J-1928 or UL 1111 standards and marked accordingly.

3.5 EQUIPMENT REQUIREMENTS – SOUND-PRODUCING DEVICES

Signaling Devices



The navigation rules require sound signals to be made under certain circumstances. Meeting, crossing, and overtaking situations described in the Navigation Rules section are examples of when sound signals are required. Recreational vessels are also required to sound signals during periods of reduced visibility.

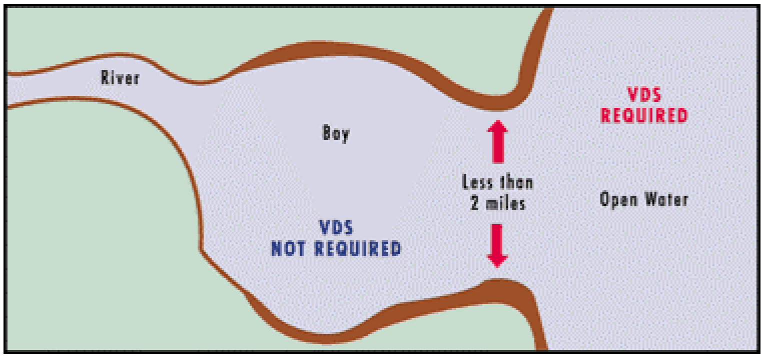
Vessels 39.4 ft/12 m or more in length are required to carry on board a whistle or horn, and a bell.

Any vessel less than 39.4 ft/12 m in length may carry a whistle or horn, or some other means to make an efficient sound signal to signal your intentions and to signal your position in periods of reduced visibility.

Therefore, any vessel less than 39.4 ft/12 m in length is required to make an efficient sound signal to signal intentions and to signal your position in periods of reduced visibility.

Vessel operators are required to carry some type of horn or whistle capable of a 4-second blast audible for 0.5 mi for all boats (athletic whistles are not acceptable on boats over 39.4 ft/12 m).

3.5.1 Visual Distress Signals



All vessels used on coastal waters, the Great Lakes, territorial seas, and those waters connected directly to them, up to a point where a body of water is less than 2 mi wide, must be equipped with USCG-approved visual distress signals. Vessels owned in the United States operating on the high seas must be equipped with USCG-approved visual distress signals.

The following vessels are not required to carry day signals but must carry night signals when operating from sunset to sunrise:

- Recreational boats less than 16 ft in length
- Boats participating in organized events such as races, regattas, or marine parades
- Open sailboats less than 26 ft in length not equipped with propulsion machinery
- Manually propelled boats.

3.5.2 Pyrotechnic Devices

Pyrotechnic visual distress signals must be USCG-approved, in serviceable condition, and readily accessible.

- They are marked with an expiration date. Expired signals may be carried as extra equipment, but cannot be counted toward meeting the visual distress signal requirement, since they may be unreliable.

- Launchers manufactured before 1 January 1981, intended for use with approved signals, are not required to be USCG-approved.

- If pyrotechnic devices are selected, a minimum of three is required; that is, three signals for day use and three signals for night. Some pyrotechnic signals meet both day and night use requirements.
- Pyrotechnic devices should be stored in a cool, dry location, if possible.

- A watertight container painted red or orange and prominently marked “DISTRESS SIGNALS” or “FLARES” is recommended.

USCG-approved pyrotechnic visual distress signals and associated devices include:

- Pyrotechnic red flares (hand-held or aerial)
- Pyrotechnic orange smoke (hand-held or floating)
- Launchers for aerial red meteors or parachute flares.

Each of these devices has a different operating (burning) time x seconds to y seconds. Check the label to see how long each pyrotechnic device will actually be illuminated. This will allow you to select a warning device better suited to the conditions where your boat will operate.

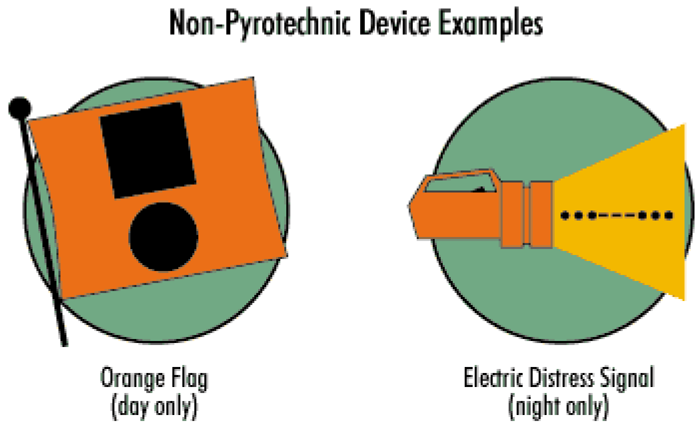
3.5.3 Non-Pyrotechnic Devices

Non-pyrotechnic visual distress signals must be in serviceable condition, readily accessible, and certified by the manufacturer as complying with USCG requirements. They include:

Orange Distress Flag

- Day signal only
- Must be at least 3 × 3 ft with a black square and ball on an orange background

- Must be marked with an indication that it meets USCG requirements in 46 CFR 160.072
- Most distinctive when attached and waved on a paddle, boathook, or flown from a mast
- May also be incorporated as part of devices designed to attract attention in an emergency, such as balloons, kites, or floating streamers.



Electric Distress Light

- Accepted for night use only
- Automatically flashes the international SOS distress signal (... --- ...)
- Must be marked with an indication that it meets USCG requirements in 46 CFR 161.013.

Under Inland Navigation Rules, a high intensity white light flashing at regular intervals from 50-70 times per minute is considered a distress signal. However, such devices do NOT count toward meeting the visual distress signal requirement.

Regulations prohibit display of visual distress signals on the water under any circumstances except when assistance is required to prevent immediate or potential danger to persons on board a vessel.

All distress signals have distinct advantages and disadvantages. No single device is ideal under all conditions or suitable for all purposes. Pyrotechnics are universally recognized as excellent distress signals. However, there is potential for injury and property damage if not properly handled. These devices produce a very hot flame and the residue can cause burns and ignite flammable materials.

Pistol launched and hand-held parachute flares and meteors have many characteristics of a firearm and must be handled with caution. In some states, they are considered a firearm and prohibited from use.

The following are just a few of the variety and combination of devices which can be carried in order to meet the requirements:

- Three hand-held red flares (day and night)
- One hand-held red flare and two parachute flares (day and night)
- One hand-held orange smoke signal, two floating orange smoke signals (day), and one electric distress light (night only).

All boaters should be able to signal for help. Boaters must have current dated USCG-approved day and night signals for all boats operating on coastal and open bodies of water.

3.6 EQUIPMENT REQUIREMENTS – POLLUTION REGULATIONS

The Refuse Act of 1899 prohibits throwing, discharging, or depositing any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States.

The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances which may be harmful into United States navigable waters. Vessels 26 ft in length and over must display a placard at least 5 × 8 in., made of durable material, fixed in a conspicuous place in the machinery spaces, or at the bilge pump control station, stating the following:

Discharge of Oil Prohibited

The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste upon or into any navigable waters of the United States. The prohibition includes any discharge that causes a film or discoloration of the surface of the water or causes a sludge or emulsion beneath the surface of the water. Violators are subject to substantial civil and/or criminal sanctions including fines and imprisonment.

Regulations issued under the Federal Water Pollution Control Act require all vessels with propulsion machinery to have a capacity to retain oil mixtures on board. A fixed or portable means to discharge oily waste to a reception facility is required. A bucket or bailer is suitable as a portable means of discharging oily waste on recreational vessels. No person may intentionally drain oil or oily waste from any source into the bilge of any vessel. You must immediately notify the USCG if your vessel discharges oil or hazardous substances in the water. Call toll-free 800-424-8802 (in Washington, D.C. [202] 267-3675).

Report the following information:

- Location
- Color
- Source
- Substances
- Size
- Time observed.

The Act to Prevent Pollution from Ships (MARPOL ANNEX V) places limitations on the discharge of garbage from vessels. It is illegal to dump plastic trash anywhere in the ocean or navigable waters of the United States. It is also illegal to discharge garbage in the navigable waters of the United States, including the Great Lakes. The discharge of other types of garbage is permitted outside of specific distances offshore as determined by the nature of that garbage.

Garbage Type	Discharge
Plastics- including synthetic ropes, fishing nets, and plastic bags	Prohibited in all areas
Floating dunnage, lining, and packing materials	Prohibited less than 25 mi from nearest land
Food waste, paper, rags, glass, metal, bottles, crockery, and similar refuse	Prohibited less than 12 mi from nearest land
Comminuted or ground food waste, paper, rags, glass, etc.	Prohibited less than 3 mi from nearest land

United States vessels of 26 ft or longer must display, in a prominent location, a durable placard at least 4 × 9 in. notifying the crew and passengers of the discharge restrictions.

United States oceangoing vessels of 40 ft or longer which are engaged in commerce or are equipped with a galley and berthing must have a written Waste Management Plan describing the procedures for collecting, processing, storing, and discharging garbage, and designate the person who is in charge of carrying out the plan.

3.7 EQUIPMENT REQUIREMENTS – MARINE SANITATION DEVICES

All recreational boats with installed toilet facilities must have an operable marine sanitation device (MSD) on board. Vessels 65 ft and under may use a Type I, II, or III MSD. Vessels over 65 ft must install a Type II or III MSD. All installed MSDs must be USCG certified. USCG-certified devices are so labeled, except for some holding tanks, which are certified by definition under the regulations.

When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited, the operator must secure the device in a manner which prevents any discharge. Some acceptable methods are: padlocking overboard discharge valves in the closed position, using non-releasable wire tie to hold overboard discharge valves in the closed position, closing overboard discharge values and removing the handle, and locking the door with padlock or keylock to the space enclosing the toilets (for Type I and Type II only.)

3.8 ADDITIONAL RECOMMENDED EQUIPMENT

Besides meeting the legal requirements, prudent boaters should carry additional safety equipment. The following additional items of equipment are suggested depending on the size, location, and use of your boat:

- Very high frequency (VHF) radio
- Boat hook
- Spare anchor
- Heaving line
- Fenders
- First aid kit
- Flashlight
- Mirror
- Searchlight
- Sunburn lotion
- Tool kit
- Ring buoy
- Whistle or horn
- Fuel tanks
- Anchor
- AM/FM radio
- Chart and compass
- Visual distress signals
- Spare propeller
- Mooring line
- Food and water
- Binoculars
- Spare batteries
- Sunglasses
- Marine hardware
- Extra clothing
- Spare parts
- Alternate propulsion (paddles)
- Dewatering device (pump or bailer)
- Spare fuel
- Pumps must work or have manual bailer

TABLE 3-1 MINIMUM REQUIRED EQUIPMENT

Equipment	Class A (Less than 16 ft)	Class 1 (16 ft to less than 26 ft)	Class 2 (26 ft to less than 40 ft)	Class 3 (40 ft to not more than 65 ft)
Personal Flotation Devices	One Type I, II, III, or IV for each person.	One Type I, II, or III for each person on board or being towed on water skis, etc., plus one Type IV available to be thrown.		
Fire Extinguisher-Portable When NO fixed fire extinguishing system is installed in machinery space(s)	At least one B-1 type approved hand portable fire extinguisher (Not required on outboard motorboat less than 26 ft in length and not carrying passengers for hire if the construction of such motorboats will not permit the entrapment of explosive or flammable gases or vapors.)		At least two B-I type approved hand portable fire extinguishers; OR at least one B-II type approved hand portable fire extinguisher.	At least three B-I type approved hand portable fire extinguishers; OR at least one B-I type *Plus* one B-II type approved hand portable fire extinguisher.
Backfire Flame Arrestor	One approved device on each carburetor of all gasoline engines installed after 25 April 1940, except outboard motors.			
Ventilation	At least two ventilator ducts fitted with cowls or their equivalent for the purpose of properly and efficiently ventilating the bilges of every engine and fuel-tank compartment of boats constructed or decked over after 25 April 1940, using gasoline or other fuel having a flashpoint less than 110°F. Boats built after 31 July 1981 must have operable power blowers.			
Whistle	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal" audible 0.5 mi.	Boats 12 to 20 m (39.4 – 65.7 ft) – device meeting technical specifications of Inland Rules Annex III audible 0.5 mi.
Bell	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats up to 12 m (39.4 ft) – any device capable of making an "efficient sound signal."	Boats 12-20 m (39.4 – 65.7 ft) – bell meeting technical specifications of Inland Rules Annex III; mouth diameter of at least 200 m (7.9 in.).
When fixed fire extinguishing system is installed in machinery space(s).	None	None	At least one B-I type approved hand portable fire extinguisher.	At least two B-I type approved hand portable fire extinguishers; OR at least one B-II type approved hand portable fire extinguisher.
	NOTE: Dry chemical and carbon dioxide are the most widely used types, in that order. The others, while acceptable, are seldom seen on boats.			

(a) Not required by the Motorboat Act of 1940; however, the "Rules of the Water" require these vessels to sound proper signals.

NOTE: Fire extinguishers manufactured after 1 January 1965 will be marked, "Marine Type, Size, Approval No. 162.028/EX." Toxic vaporizing-liquid type fire extinguishers, such as those containing carbon tetrachloride or chlorobromomethane, are not accepted as required approved extinguishers on uninspected vessels (private pleasure craft).

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4. NAVIGATION RULES

Navigation rules require vessels to display lights and shapes under certain conditions.

4.1 NAVIGATION LIGHTS

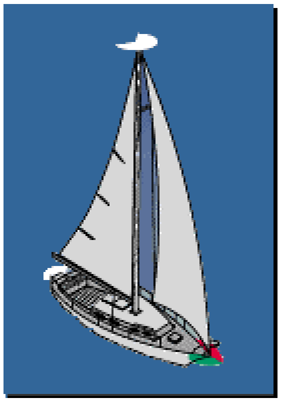
Recreational vessels are required to display navigation lights between sunset and sunrise and other periods of reduced visibility (fog, rain, hazy, etc.). The USCG Navigation Rules, International-Inland, specifies lighting requirements for every description of water craft. The information provided here is intended for power-driven and sailing vessels less than 65.5 ft/20 m in length.

4.2 POWER-DRIVEN VESSELS

If your vessel is less than 65.5 ft/20 m in length, then it must display navigation lights per Figure 4-1.

If your vessel is less than 39.4 ft/12 m in length, then it may display navigation lights per Figure 4-2.

Figure 4-1.



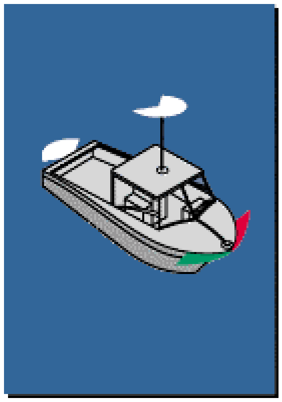
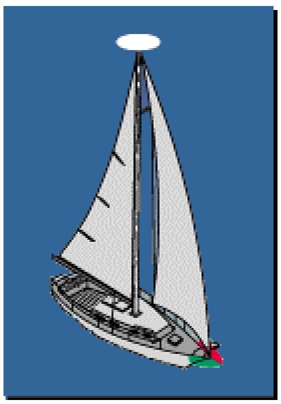
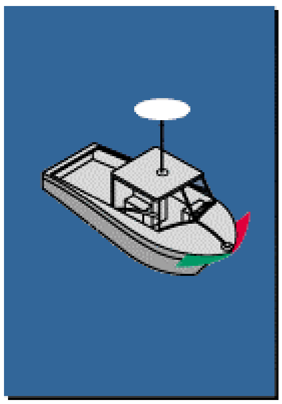


Figure 4-2.





If your vessel is less than 23 ft/7 m in length and its maximum speed cannot exceed 7 knots, then it may display an all-around white light, and if practicable, sidelights instead of the lights prescribed previously (for international rules only).

For vessels less than 39.4 ft/12 m in length, the masthead or all-around white light must be at least 1 m above the sidelights.

Sidelights may be a combination light instead of two separate lights.

4.3 SAILING VESSELS

If your vessel is less than 65.6 ft/20 m in length, then it must display navigation lights shown on Figures 4-3, 4-4, or 4-5.

Figure 4-3.

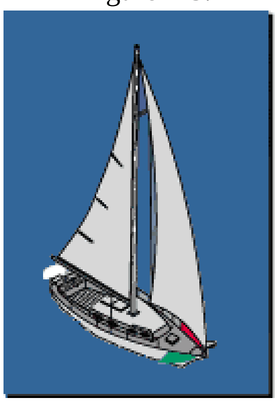


Figure 4-4.

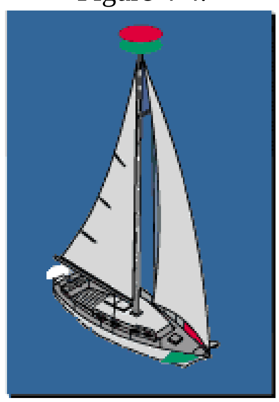
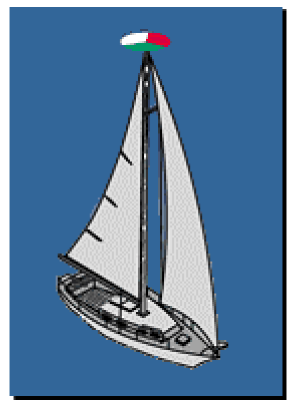


Figure 4-5.



If your vessel is less than 23 ft/7 m in length, then it should display lights for a sailboat (Figure 4-3), if practicable. As an option, your vessel may carry a flashlight or lighted lantern that can show a white light in sufficient time to prevent collision (Figure 4-6).

4.3.1 Vessel under Oars

If your vessels is under oars, then it should display lights for a sailboat (Figures 4-3, 4-4, or 4-5), if practicable. As an option, your vessel may carry an electric torch (flashlight) or lighted lantern that can show a white light in sufficient time to prevent collision (Figure 4-7).

Figure 4-6.

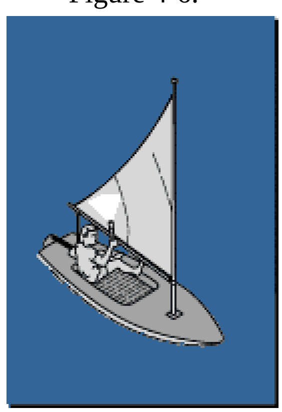
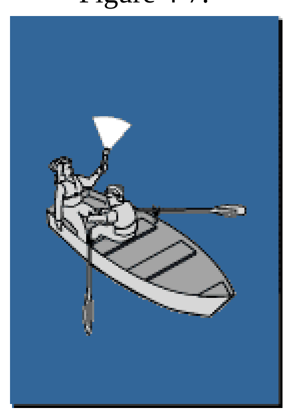


Figure 4-7.



4.3.2 Lights and Shapes

To alert other vessels of conditions that may be hazardous, there are requirements to display lights at night and shapes during the day.

4.3.3 Anchored Vessels

AT NIGHT: All vessels at anchor must display anchor lights. If your vessel is less than 164 ft/50 m in length, then its anchor light is an all-around white light visible where it can best be seen from all directions (Figure 4-8).

DURING THE DAY: All vessels at anchor must display, forward where it can be best seen, a black ball shape conditions (Figure 4-9).

Figure 4-8.

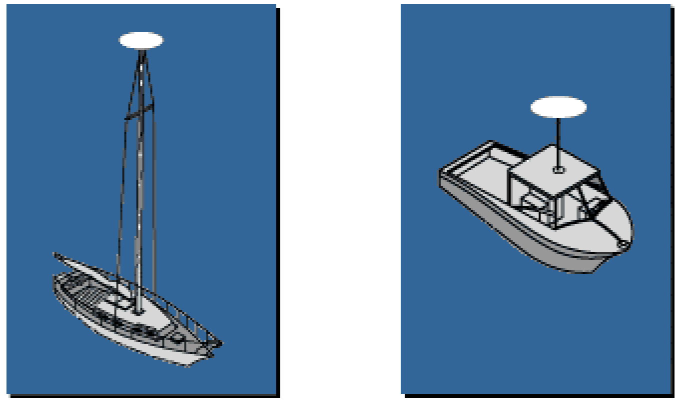
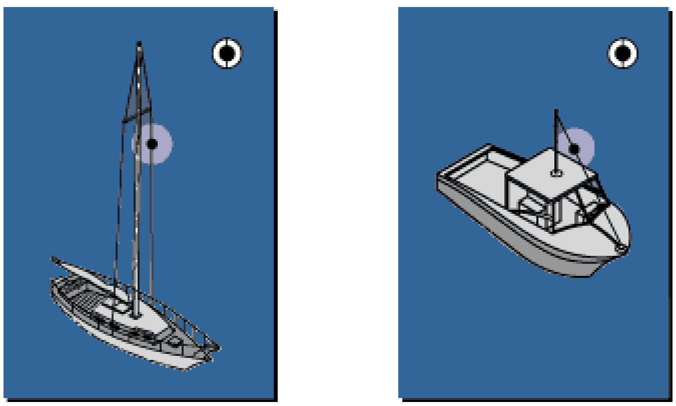
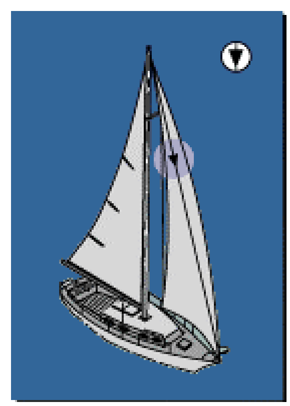


Figure 4-9.



EXCEPTIONS: If your vessel is less than 23 ft/7 m in length, then it is not required to display an anchor light or shape unless it is anchored in or near a narrow channel, fairway or anchorage, or where other vessels normally navigate. If your vessel is less than 65.6 ft/20 m in length, then is not required to display an anchor light if it is anchored in Inland Waters in a special anchorage designated by the Secretary of Transportation.

Figure 4-10.



4.3.4 Sailing Vessels under Power (Machinery)

During the day, vessels under sail also being propelled by machinery must exhibit forward, where best seen, a black conical shape with the apex pointing down (Figure 4-10).

EXCEPTION: If your vessel is less than 39.4 ft/12 m in length, then it is not required to display the shape in Inland Waters.

REMINDER: If you are operating your sail vessel at night using machinery or sail and machinery, then your vessel must display lights required for a power-driven vessel (Figures 4-1 or 4-2).

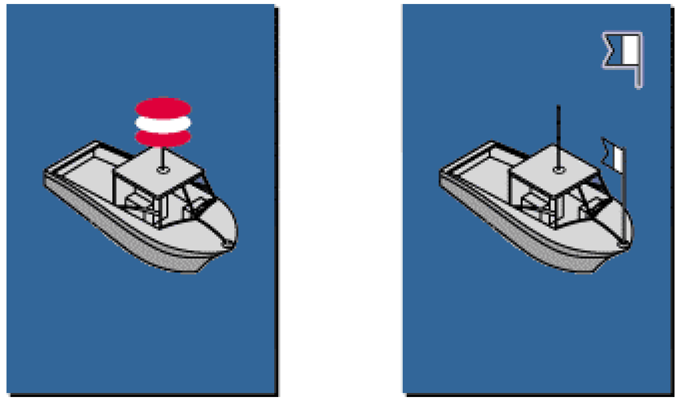
4.3.5 Restricted Maneuverability

The Navigation Rules require vessels restricted in their ability to maneuver to display appropriate day shapes or lights. To meet this requirement, if your vessel is engaged in diving activities during the day, then it must exhibit a rigid replica of the international code flag "Alpha" not less than 3.3 ft/1 m above deck. If diving activities are at night, then your vessel must display the navigation lights shown on

Figure 4-11. This requirement does not affect the use of a red and white divers flag which may be required by state or local law to mark a diver's location. The "A" flag is a navigation signal indicating the vessel's restricted maneuverability and does not pertain to the diver.

All vessels 16 ft or greater must have operable navigation lights and an all around anchor light. Sailboats capable of both power and sail must be able to display navigation lights for both systems.

Figure 4-11.



Tables 4-1 and 4-2 provide the required lights for various types of vessels for inland and international rules, respectively.

TABLE 4-1 LIGHTS FOR VARIOUS TYPES OF VESSELS – 1980 INLAND RULES

No.	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
1	Power-driven vessel 12 m but less than 20 m in length	White, 225°, visibility 3 mi; at least 2.5 m above gunwale[(a)]	Separate red and green 112 ½° or combination, visibility 2 mi; above hull at least 1 m below masthead light[(b)]	White 135°, visibility 2 mi	---
2	Power-driven vessel less than 12 m in length	White, 225°, visibility 2 mi; can be less than 2.5 m above gunwale, but at least 1 m above side lights[(a),(c)]	Separate red and green 112 ½° or combination, visibility 1 mi; above hull at least 1 m below masthead light[(b),(c)]	White 135°, visibility 2 mi	---
3	Sailing vessel under 20 m in length	None	Separate red and green, 112 ½°, or combination, visibility 2 mi[(b),(d)]	White 135°, visibility 2 mi	Optional—two all-round lights at or near top of mast, red over green, separated at least 1 m, visibility 2 mi
4	Sailing vessel under 12 m in length	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[(b),(d),(e)]	White 135°, visibility 2 mi[(d),(e)]	---
5	Vessel propelled by oars	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[(f)]	May show white, 135°, visibility 2 mi[(f)]	---
6	Power-driven vessel 20 but less than 50 m in length	White, 225°, visibility 5 mi; not more than ½ of length aft from stem; 6 m or beam (up to 10 m) above hull	Red and green, 112 ½°, visibility 2 mi; at or near sides of vessel; above hull at least 1 m below masthead light	White, 135°, visibility 2 mi	After masthead light may be shown; at least 4.5 m higher than forward masthead light
7	Power-driven vessel 50 m or more in length	White, 225°, visibility 6 mi; not more than ½ of length aft from stem; 6 m or beam (up to 10 m) above hull	Red and green, 112 ½°, visibility 3 mi; at or near sides of vessel; above hull at least 1 m below masthead light	White, 135°, visibility 3 mi	After masthead light required; at least 4.5 m higher and ¼ of vessel length (up to 50 m) aft of forward masthead light
8	Vessel towing: tow less than 200 m overall from stern of towing vessel; (also towing alongside or pushing ahead)	Two white, arranged vertically, 225°, visibility determined by length of vessel (not required pushing ahead or towing alongside on western rivers)	Normal for size of vessel	Normal for size of vessel	Towing astern: towing light[(g)] over stern light; pushing ahead or towing alongside: two towing lights[(g)] vertically
9	Vessel towing: tow 200 m or more overall length	Three white, arranged vertically, 225°, visibility determined by length of vessel	Normal for size of vessel	Normal for size of vessel	Towing light: yellow, 135°, above sternlight[(g)]
10	Vessel being towed astern, if manned	None	Normal for size of vessel	Normal for size of vessel	
11	Vessel being towed alongside or pushed ahead	None	Normal for size of vessel; at forward end	Normal for size of vessel (not used for pushed ahead)	Also "special flashing light" at center or forward end; a group of vessels is lighted as a single vessel

(a) After masthead light may be shown but not required (exception allowed on Great Lakes).
(b) Fitted with inboard screens if necessary to prevent being seen across bow.
(c) Less than 12 m in length, need only have all-round white light, visibility 2 mi but should have side lights.
(d) May be combined into triple combination light at masthead.
(e) Less than 7 m, need only have flashlight or lantern to show.
(f) Need only have flashlight or lantern to show white light.
(g) Visibility 3 mi for vessels 50 m or more in length; 2 mi for shorter vessels.

No.	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
12	Vessel engaged in trolling or drift fishing	[h]	[h]	[h]	---
13	Vessel engaged in trawling	None[a][b]	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all-round lights, green over white[g],[i],[j],[k]
14	Vessel engaged in fishing, other than trawling (or trolling)	None[l]	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all-round lights, red over white[g],[i],[j],[k][l]; when not actually fishing, show normal masthead lights for vessel its size
15	Vessel at anchor, less than 50 m in length	None	None	None	White, all-round light where can best be seen; visibility 2 mi (not required if less than 7 m in length and not anchored in a narrow channel or where vessels normally navigate)
16	Vessel at anchor; 50 m or more in length	None	None	None	White, all-round light in fore part of vessel not less than 6 m above hull; a second white, all-round light in after part, not less than 4.5 m lower than forward anchor light; visibility 3 mi
17	Vessel aground	None	None		Anchor light(s) as line 15 or 16 plus two red all-round lights of same visibility range[g],[i],[j] (not required if less than 12 m in length)
18	Pilot vessel	None if on pilot duty; normal if underway and not on pilot duty	When underway, normal for size of vessel	When underway, normal for size of vessel	Two all-round lights, white over red, at masthead[g],[i],[j]; if at anchor, normal anchor light(s); line 15 or 16
19	Vessel not under command	None	If making way through the water, normal for size of vessel	If making way through the water, normal for size of vessel	Two red all-round lights vertically where best can be seen[g],[i],[j]
20	Vessel restricted in ability to maneuver	None	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Three all-round lights vertically, red-white-red.[g],[i]; if at anchor, normal anchor light(s) (not required if less than 12 m in length)

(h) Show only normal lights of power-driven or sailing vessel.
(i) Vertical spacing 1 m.
(j) Lower light not less than 4 m (2 m if under 20 m in length) above hull.
(k) Lower light above sidelights at least twice vertical spacing.
(l) When not actually fishing, show normal masthead lights for vessel its size.

TABLE 4-2 LIGHTS FOR VARIOUS TYPES OF VESSELS –1972 INTERNATIONAL RULES

	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
A	Power-driven vessel 12 m but less than 20 m in length	White, 225°, visibility 3 mi. At least 2.5 m above gunwale[a].	Separate red and green, 112 ½°, or combination, visibility 2 m; above hull at least 1 m below masthead light[b]	White, 135°, visibility 2 mi	---
B	Power-driven vessel less than 12 m in length	White, 225°, visibility 2 mi. Can be less than 2.5 m above gunwale, but at least 1 m above side lights[c]	Separate red and green, 112 ½°, or combination, visibility 1 mi; above hull at least 1 m below masthead light[b]	White, 135°, visibility 2 mi	---
C	Sailing vessel under 20 m in length	None	Separate red and green, 112 ½°, or combination, visibility 2 mi	White, 135°, visibility 2 mi	Optional – two all-round lights at or near top of mast, red over green, separated at least 1 m, visibility 2 mi.
D	Sailing vessel under 12 m in length	None	Separate red and green, 112 ½°, or combination, visibility 1 mi[b][d]	White, 135°, visibility 2 mi[d][e]	---
E	Vessel propelled by oars	None	May show separate red and green, 112 ½°, or combination, visibility 1 mi[f]	May show white, 135°, visibility 2 mi[f]	---
F	Power-driven vessel 20m but less than 50 m in length	White, 225°, visibility 5 mi. Not more than ¼ of length aft from stem; 6 m or beam (up to 12 m) above hull.	Red and green, 112 ½°, visibility 2 mi. At or near sides of vessel; not more than ¾ height of masthead light	White, 135°, visibility 2 mi	After masthead light may be shown; at least 4.5 m higher than forward masthead light
G	Power-driven vessel 50 m or more in length	White, 225°, visibility 6 mi. Not more than ¼ of length aft from stem; 6 m or beam (up to 12 m) above hull.	Red and green, 112 ½°, visibility 3 mi. At or near sides of vessel; not more than ¾ height of forward masthead light	White, 135°, visibility 3 mi	After masthead light required; at least 4.5 m higher and half of vessel length (up to 100 m) aft of forward masthead light
H	Vessel towing; tow from stern of towing less than 200 m overall vessel. (Also towing alongside or pushing ahead)	Two white, arranged vertically, 225°, visibility determined by length of vessel.	Normal for size of vessel	Normal for size of vessel	Towing light[g] over sternlight (not shown when towing alongside or pushing ahead)
I	Vessel towing; tow 200 m or more overall length	Three white, arranged vertically, 225°, visibility determined by length of vessel	Normal for size of vessel	Normal for size of vessel	Towing light[g] over stern light

(a) After masthead light may be shown but not required.
(b) Fitted with inboard screens if necessary to prevent being seen across bow.
(c) Less than 7 m and less than 7 kt max speed need only have all-round white light, visibility 2 mi but should have sidelights.
(d) May be combined into triple combination light at masthead.
(e) Less than 7 m need only have flashlight or lantern to show.
(f) Need only have flashlight or lantern to show white light.
(g) Visibility 3 mi for vessels 50 m or more in length; 2 mi for shorter vessels.

	Vessel	Masthead (Forward)	Side	Stern	Additional Lights or Remarks
J	Vessel being towed astern, if manned	None	Normal for size of vessel	Normal for size of vessel	
K	Vessel being towed alongside or pushed ahead	None	Normal for size of vessel; at forward end	Normal for size of vessel (not used for pushed ahead)	A group of vessels is lighted as a single vessel
L	Vessel engaged in trolling or drift fishing	(h)	(h)	(h)	---
M	Vessel engaged in trawling	None(i)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all- round lights, green over white(g)(j)(k)(l)
N	Vessel engaged in fishing, other than trawling (or trolling)	None(i)	When making way through the water, normal for size of vessel	When making way through the water, normal for size of vessel	Underway or at anchor, two all- round lights, red over white(g)(j)(k)(l)
O	Vessel at anchor, less than 50 m in length	None	None	None	White, all-round light where can best be seen; visibility 2 mi (not required if less than 7 m in length and not anchored in a narrow channel or where vessels normally navigate)
P	Vessel at anchor; 50 m or more in length	None	None	None	White, all-round light in fore part of vessel not less than 6 m above hull; a second white all-round light in after part, not less than 4.5 m lower than forward anchor light; visibility 3 mi.
Q	Vessel aground	None	None		Normal anchor light(s) plus two red all-round lights of same visibility range
R	Pilot vessel	None if on pilot duty; normal if underway and not on pilot duty	When underway, normal for size of vessel	When underway, normal for size of vessel	Two all-round lights, white over red, at masthead(g)(j)(k); if at anchor, normal anchor light(s)
S	Vessel not under command	None	If making way through the water, normal for size of vessel	If making way through the water, normal for size of vessel	Two red all-round lights vertically where best can be seen(g)(j)(k)
T	Vessel constrained by her draft	Normal for size of vessel	Normal for size of vessel	Normal for size of vessel	Three red all-round lights, arranged vertically and equally spaced.(g)(j)(k)

(h) Show only normal lights of power-driven or sailing vessel.
(i) When not actually fishing, show normal masthead lights for vessel its size.
(j) Vertical spacing 2 m for vessels 20 m or more in length, 1 m for shorter vessels.
(k) Lower light not less than 4 m (2 m if under 20 m in length) above hull.
(l) Lower light above sidelights at least twice vertical spacing.

5. INLAND "RULES OF THE WATER"

5.1 MEETING SITUATIONS

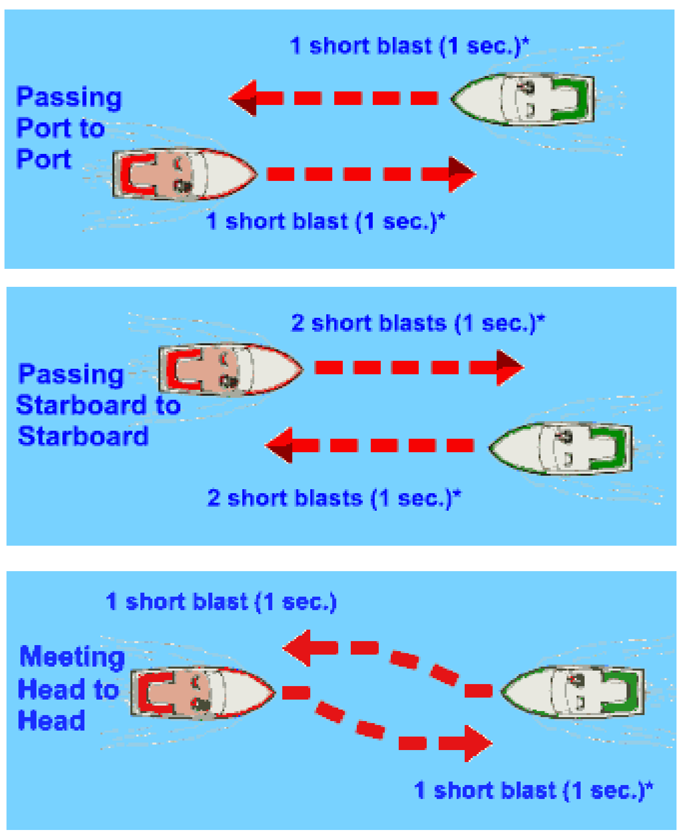
In the following situations, the give-way vessel must take action to keep well clear. The stand-on vessel should maintain its course and speed. If it becomes apparent that the actions taken (or not taken) by the give-way vessel are dangerous or insufficient, you should take action to avoid collision.

5.1.1 Meeting Head-On

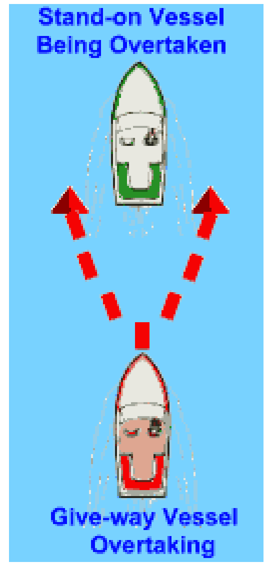
When two power driven vessels are approaching head-on or nearly so, either vessel will indicate its intent which the other vessel will answer promptly. In a meeting situation, neither vessel is the stand-on vessel.

It is generally accepted that you should alter course to starboard and pass port-to-port. The accompanying sound signal is one short blast. If you cannot pass port-to-port due to an obstruction or other vessels, you should sound two short blasts to indicate your intention to pass starboard-to-starboard. Make sure the other vessel understands your intent before proceeding. The other vessel should return your two-short-blast signal.

- Not sounded on International Waters



5.1.2 Overtaking

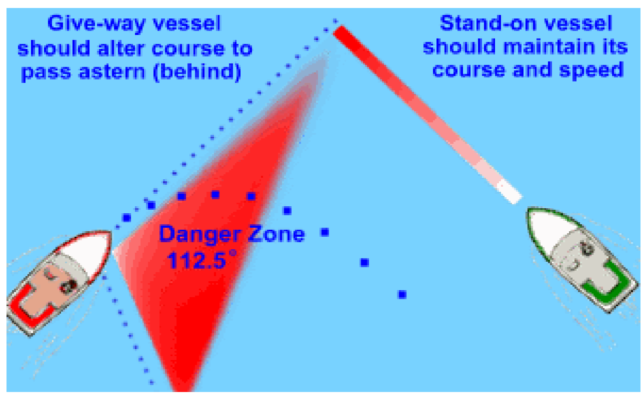


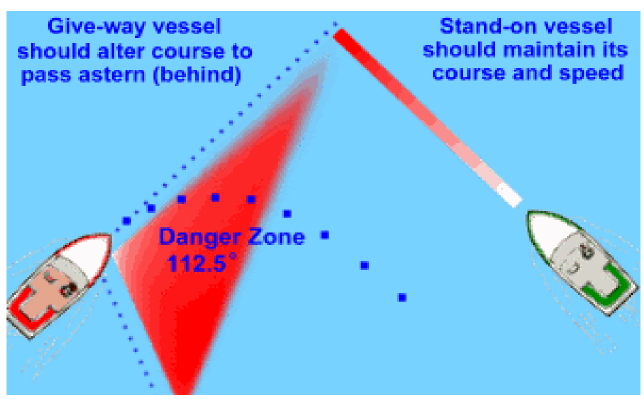
When two vessels are moving in the same direction, and the astern vessel wishes to pass, it must initiate the signal to pass as shown in the diagram. The vessel passing is the give-way vessel and should keep out of the way of the vessel being passed. The vessel being passed is the stand-on vessel and must maintain its course and speed. If the stand-on vessel realizes that the course intended by the give-way vessel is not safe, it should sound the danger or doubt signal.

If you are the overtaking vessel, remember that you are the give-way vessel until well past, and safely clear of, the passed vessel. Do not cut in front, impede, or endanger another vessel.

Inland Rules: "I intend to pass you on your port side" *2 short blasts (1 second)* "Agreement" *2 short blasts (1 second)*	**Inland Rules:** "I intend to pass you on your starboard side" *1 short blast (1 second)* "Agreement" *1 short blast (1 second)*
International Rules: "I intend to pass you on your port side" *2 prolonged blasts/2 short* "Agreement" *1 prolonged/1 short/1 prolonged/1 short*	**International Rules:** "I intend to pass you on your starboard side" *2 prolonged blasts/1 short* "Agreement" *1 prolonged/1 short/1 prolonged/1 short*

5.1.3 Crossing



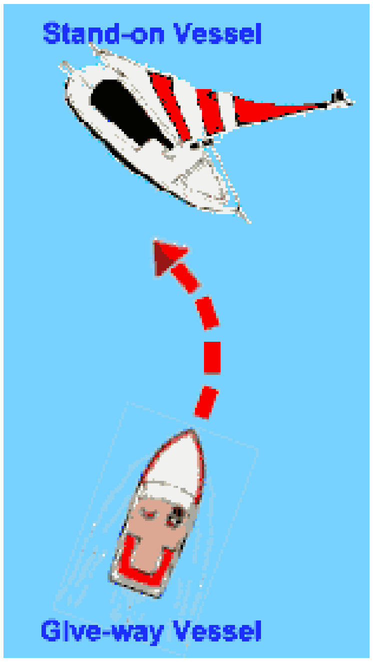


When two power driven vessels are approaching at right angles or nearly so, and risk of collision exists, the vessel on the right is the stand-on vessel and must hold its course and speed. The other vessel, the give-way vessel, will maneuver to keep clear of the stand-on vessel and will pass it by its stern. If necessary, slow or stop or reverse until the stand-on vessel is clear.

In the example above, the red vessel is the give-way vessel and should alter course and speed to pass behind the green vessel. If the skipper of the green vessel does not observe the red vessel taking action to avoid collision, then he/she must take the required action to avoid a collision.

5.1.4 Sailing Craft and Vessels Propelled by Oars or Paddles

Sailing craft and boats propelled by oars or paddles have the right-of-way over power driven vessels. An exception to this is if the sailing craft or self-propelled vessel is passing a power driven vessel. In an overtaking situation, the overtaking vessel is the give-way vessel, even if it is not propelled by an engine.



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5.1.5 Navigating Narrow Channels

The rules tell you to stay to the starboard side of narrow channels. Make sure that you do not impede a vessel that is constrained by draft, i.e., a large vessel that must operate within the channel in order to make way safely. When crossing a channel, do so at a right angle and in such a way as to avoid causing the traffic in the channel to make course or speed changes. Do not anchor in a channel unless you cannot make way (broken down, etc.).

When operating on the Great Lakes, Western rivers and other designated rivers, the down bound vessel (going with the current) has the right of way over a vessel going upstream. This is because a vessel going upstream can maneuver better than a vessel going downstream.
If you approach a bend in a river around which you cannot see, sound one prolonged blast to alert vessels approaching from the other side of the bend that you are there. If another vessel is around the bend, it should answer with one prolonged blast. Conversely, if you hear a prolonged blast as you approach the bend, answer with a prolonged blast.

5.1.6 Commercial Vessel Situations

If at all possible stay out of areas where there is commercial vessel traffic such as shipping lanes or traffic separation zones. Large ships and barges have special problems in maneuvering and **cannot and will not** get out of your way.

If you must operate around commercial vessels take heed of the following:

- Avoid ship channels; if you must cross, do so at right angles and as quickly as possible
- Be alert; watch for traffic
- Be seen, especially at night
- Know the sound signals, especially the danger or doubt signal
- Keep your VHF radio tuned to Channel 16 and listen carefully
- Order all aboard to wear PFDs
- Be familiar with the area and have current navigation charts
- Do not be a non-survivor of a collision with a large ship.

6. SEAMANSHIP

Seamanship is defined as " the knowledge of and skill in all things pertaining to the operation, navigation, and maintenance of a ship." This knowledge may include; handling and working with rope, wire, and various boat hardware. Basic engine and boat electrical layout maintenance and troubleshooting. Piloting including boat handling, engine operation, proper use of charts, and use of navigation equipment (i.e., depth finders, compass, Global Positioning System (GPS) or loran units, speedometer). A fundamental knowledge of weather (wind, fronts, and cloud types) and the water environment (wave action, tides, and currents). Proper emergency preparation training, basic first aid knowledge, and survival techniques are an integral part of seamanship.

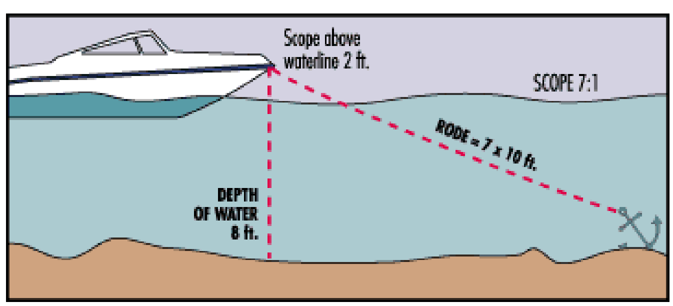
Seamanship skills are developed through training courses, such as the USCG Auxiliary Training course, through training manuals, regulatory handbooks, instructional guides and videos, and most importantly through actual hands on experience and working with people who have developed the skills.

6.1 ANCHORING

Anchoring is done for two principal reasons: first, to stop for fishing, lunch, or an overnight stay and second, to keep you from running aground in bad weather or as a result of engine failure. Anchoring can be a simple task if you follow these guidelines:

- Make sure you have the proper type of anchor (danforth/plow/mushroom).
- A 3- to 6-ft length of galvanized chain should be attached to the anchor. The chain will stand up to the abrasion of sand, rock, or mud on the bottom much better than a fiber line.
- A suitable length of nylon anchor line should be attached to the end of the chain (this combination is called the "Rode"). The nylon will stretch under heavy strain cushioning the impact of the waves or wind on the boat and the anchor.
- Select an area that offers maximum shelter from wind, current, and boat traffic.
- Determine depth of water and type of bottom (preferably sand or mud).
- Calculate the amount of anchor line you will need. General rule: 5-7 times as much anchor line as the depth of water plus the distance from the water to where the anchor will attach to the bow. For example, if the water depth is 8 ft and it is 2 ft from the top of water to your bow cleat, you would multiply 10 ft by 5-7 to get the amount of anchor line to put out (Figure 6-1).

Figure 6-1.



- Secure the anchor line to the bow cleat at the point you want it to stop.
- Bring the bow of the vessel into the wind or current.

- When you get to the spot you want to anchor, place the engine in neutral.
- When the boat comes to a stop, slowly lower the anchor. Do not throw the anchor over, as it will tend to entangle the anchor.
- When all anchor line has been let out, back down on the anchor with engine in idle reverse to help set the anchor.
- When anchor is firmly set, use reference points (landmarks) in relation to the boat to make sure you are not drifting. Check these points frequently.
- Maximum anchoring is achieved at an angle of less than 8 degrees.

The following table provides anchor weights:

Boat Length (Maximum)	Lunch Hook	Working Anchor	Storm Anchor
20 ft	**4** (10)	**5** (20)	**12** (40)
30 ft	**5** (15)	**12** (30)	**18** (60)
40 ft	**12** (20)	**18** (40)	**28** (80)
NOTE: Bold indicates figures based on modern lightweight burial-type anchors of efficient design. Figures in parentheses show how weights would be increased, using a formula of 0.5 lb, 1 lb, and 2 lb per foot for certain kedges.			

Table 6-1 provides suggested rode and anchor sizes.

6.2 WEATHER

You should never leave the dock without first checking the local weather forecast. You can get the weather information from the TV, radio, local, newspaper, on-line, or from one of the weather channels on your VHF radio.

At certain times of the year weather can change rapidly and you should continually keep a "weather eye" out. While you are out in a boat, here are a few signs you can look for that indicate an approaching weather change:

- Weather changes generally come from the west. Scan the sky with your weather eye, especially to the west.
- Watch for cloud to build up, especially rapid vertically rising clouds.
- Sudden drop in temperature.
- Sudden change in wind direction and/or speed.
- If you have a barometer on your boat, check it every 2-3 hours. A rising barometer indicates fair weather and rise in wind velocity; a falling barometer indicates stormy or rainy weather.

TABLE 6-1 SUGGESTED RODE AND ANCHOR SIZES[a]

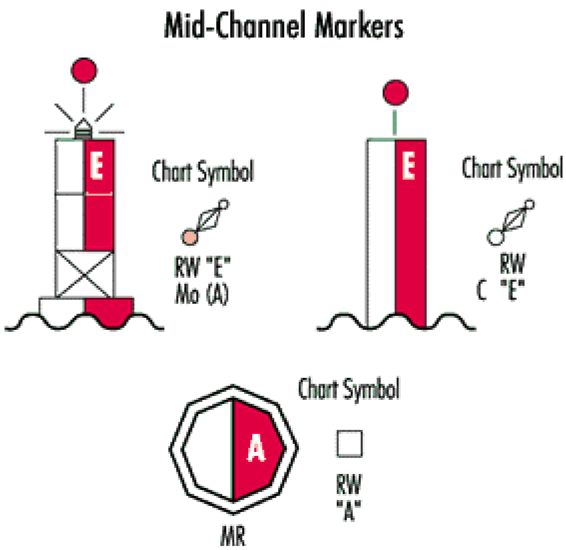
L.O.A.	Beam		Rode		Anchor		
	Sail	Power	Nylon	Chain	Northill	Standard	Hi-Tensile
FOR STORM ANCHOR (WINDS UP TO 60 KNOTS)							
10 ft	5 ft	5 ft	100 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
15 ft	7 ft	7 ft	125 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
20 ft	8 ft	9 ft	150 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H
25 ft	9 ft	10 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	22-S	12-H
30 ft	10 ft	11ft	250 ft-7/16 in.	5 ft-5/16 in.	46 lb (20-R)	22-S	20-H
35 ft	12 ft	13 ft	300 ft-1/2 in.	6 ft-3/8 in.	46 lb (20-R)	40-S	35-H
40 ft	13 ft	14 ft	400 ft-5/8 in.	8 ft-7/16 in.	80 lb (30-R)	65-S	60-H
50 ft	14 ft	16 ft	500 ft-5/8 in.	8 ft-7/16 in.	105 lb (50-R)	130-S	60-H
60 ft	16 ft	19 ft	500 ft-3/4 in.	8 ft-1/2 in.	105 lb (50-R)	180-S	90-H
FOR WORKING ANCHOR (WINDS UP TO 30 KNOTS)							
10 ft	5 ft	5 ft	80 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
15 ft	7 ft	7 ft	100 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	8-S	5-H
20 ft	8 ft	9 ft	120 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
25 ft	9 ft	10 ft	150 ft-3/8 in.	3 ft-3/16 in.	12 lb (6-R)	8-S	5-H
30 ft	10 ft	11ft	180 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H
35 ft	12 ft	13 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	22-S	12-H
40 ft	13 ft	14 ft	250 ft-7/16 in.	5 ft-5/16 in.	46 lb (20-R)	22-S	20-H
50 ft	14 ft	16 ft	300 ft-1/2 in.	6 ft-3/8 in.	46 lb (20-R)	40-S	35-H
60 ft	16 ft	19 ft	300 ft-1/2 in.	6 ft-3/8 in.	80 lb (30-R)	65-S	35-H
FOR LUNCH HOOK							
10 ft	5 ft	5 ft	70 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
15 ft	7 ft	7 ft	80 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
20 ft	8 ft	9 ft	90 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	2 ½ -S	5-H
25 ft	9 ft	10 ft	100 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
30 ft	10 ft	11ft	125 ft-1/4 in.	3 ft-3/16 in.	6 lb (3-R)	4-S	5-H
35 ft	12 ft	13 ft	150 ft-1/4 in.	3 ft-3/16 in.	12 lb (6-R)	4-S	5-H
40 ft	13 ft	14 ft	175 ft-3/8 in.	4 ft-1/4 in.	12 lb (6-R)	8-S	5-H
50 ft	14 ft	16 ft	200 ft-3/8 in.	4 ft-1/4 in.	12 lb (6-R)	8-S	12-H
60 ft	16 ft	19 ft	200 ft-3/8 in.	4 ft-1/4 in.	27 lb (12-R)	13-S	12-H

(a) Suggested sizes assume fair holding ground, scope of at least 7-to-1 and moderate shelter from heavy seas.

Plow Anchors—Woolsey, manufacturer of the Plowright anchor, makes the following recommendations for winds up to 30 knots: for *working anchors*, 10-21 ft, 6 lb; 22-32 ft, 12 lb; 32-36 ft, 18 lb; 36-39 ft, 22 lb; and 39-44 ft, 35 lb. For *lunch hooks*, they advise stepping down one size. For *storm anchors*, up one size.
Kedges—Holding powers vary widely with the type. Best to consult manufacturer for individual recommendations.

7. AIDS TO NAVIGATION

Aids to navigation are placed along coasts and navigable waters as guides to mark safe water and to assist mariners in determining their position in relation to land and hidden dangers. Each aid to navigation is used to provide specific information.



Several aids to navigation are usually used together to form a local aid to navigation system that helps the mariner follow natural and improved channels. Such aids to navigation also provide a continuous system of charted marks for coastal piloting. Individual aids to navigation are used to mark landfall from seaward, and to mark isolated dangers.

Lateral markers are buoys or beacons that indicate the port and starboard sides of a route to be followed. Virtually all U.S. lateral marks follow the traditional 3R rule of “red, right, returning.” This means, when returning from sea, keep red marks on the right-hand (starboard) side of the vessel.

Mariners must NOT rely on buoys alone for determining their position. Storms and wave action can cause buoys to move.

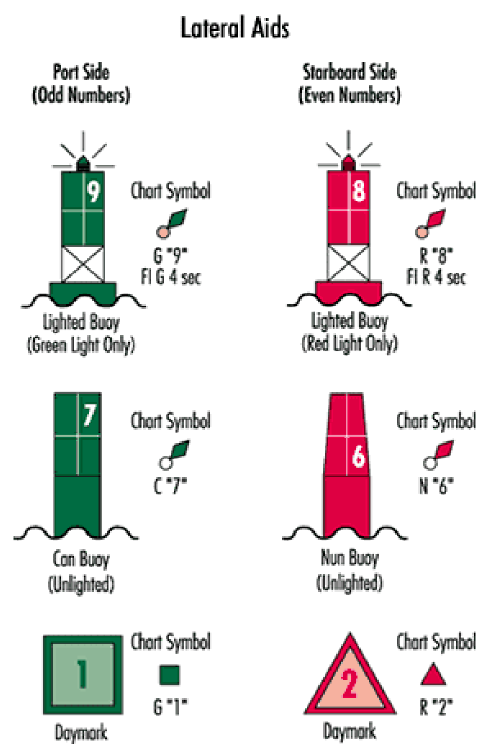
7.1 LATERAL AIDS

Lateral aids marking the sides of channels as seen when entering from seaward.

Do not tie up to Aids to Navigation; it is dangerous and illegal.

7.2 NAUTICAL CHARTS

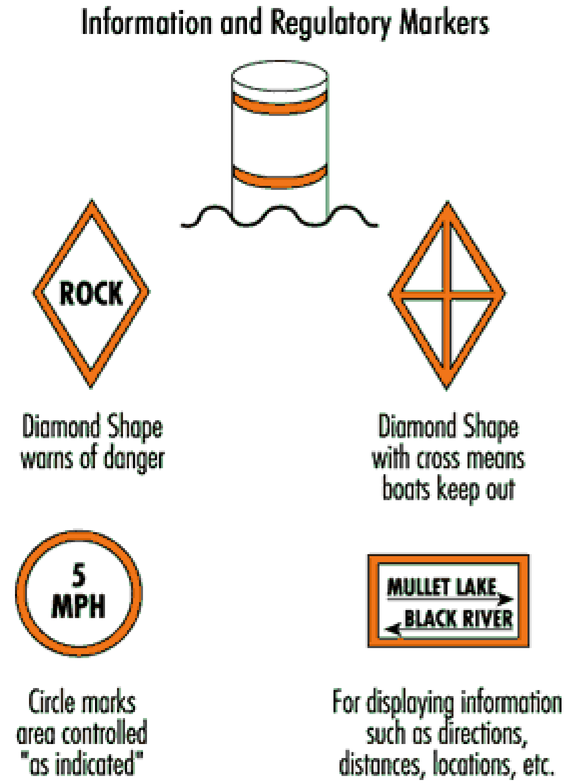
One of the most important tools used for safely navigating waterways are Nautical Charts. Nautical Charts show the nature and shape of the coast, depths of water, general configuration and character of the bottom, prominent landmarks, port facilities, aids to navigation, marine hazards, and other pertinent information. Changes brought about by people and nature require that nautical charts be constantly maintained and updated to aid safe navigation.



To meet the needs of the boaters, the National Ocean Service (NOS) produces a variety of nautical charts and chart products. The date of a nautical chart is critical to the boater. Only up-to-date charts should be used for navigation. Nautical charts vary in scale and format. For coastal navigation, for instance, boaters should use the largest chart scale available. Chart updating information can be obtained from "Local Notice to Mariners" published by the USCG.

NOS nautical charts may be purchased either directly by mail from the NOS Distribution Branch or through an authorized agent. There are more than 1,700 nautical chart agents that sell NOS charts.

Other charts available consist of tide and current charts for various localities and a local notice to mariners. These local charts should be used with NOS Charts.



8. ELECTRONICS

8.1 EQUIPMENT REQUIREMENTS – RADIO REGULATIONS

8.1.1 Carrying a Radio

Most recreational vessels under 65.6 ft/20m in length do not have to carry a marine radio. Any vessel that carries a marine radio must follow the rules of the Federal Communications Commission (FCC).

8.1.2 Radio Licenses

The FCC does not require operators of recreational vessels to carry a radio or to have an individual license to operate VHF marine radios (with or without digital selective calling capability), Emergency Position Indicating Radio Beacons (EPIRBs), or any type of radar. Operators must, however, follow the procedures and courtesies that are required of licensed operators specified in FCC Rules. You may use the name or registration number of your vessel to identify your ship station.

Users of VHF marine radio equipped with digital selective calling will need to obtain a maritime mobile service identity number from the FCC. It is unlawful to use digital selective calling without obtaining this identity.

The following vessels are still required to be licensed:

- Vessels that use medium frequency/high frequency single side-band radio, satellite communications, or telegraphy
- Power driven vessels over 65.6 ft/20 m in length
- Vessels used for commercial purposes including:
  - Vessels documented for commercial use, including commercial fishing vessels
  - CG inspected vessels carrying more than 6 passengers
  - Towboats more than 7.8 m in length
  - Vessels of more than 100 tons certified to carry at least 1 passenger
  - Cargo ships over 300 tons
- Any vessel, including a recreational vessel, on an international voyage.

8.1.3 Radio Listening Watch

Vessels not required to carry a marine radio (e.g., recreational vessels less than 20-m length), but which voluntarily carry a radio, must maintain a watch on Channel 16 (156.800 MHz) whenever the radio is operating and not being used to communicate. Such vessels may alternatively maintain a watch on VHF Channel 9 (156.450 MHz), the boater calling channel.

U.S. vessels required to carry a VHF marine radio, such as commercial fishing vessels, must maintain a watch on Channel 16 (156.800 MHz) while underway whenever the radio is not being used for exchanging communications.

False Distress Alerts

It is unlawful to intentionally transmit a false distress alert, or to unintentionally transmit a false distress alert without taking steps to cancel that alert.

Very High Frequency Marine Radio Channels

The chart below contains a partial listing of channels recreational boaters should be familiar with:

Channel	Type of Message and Use
06	Intership Safety: Used for ship-to-ship safety messages and search messages and ships and aircraft of the USCG.
09	Boater Calling: FCC has established this channel as a supplementary calling channel for non-commercial vessels (recreational boaters). The purpose is to relieve congestion on VHF Channel 16. The USCG announces urgent marine information broadcasts and storm warnings on Channel 9 in the First USCG District (waters off the coast of northern New Jersey, New York, and New England) and USCG Group Grand Haven, Milwaukee and Sault Ste. Maria (Lake Michigan). For that reason, we strongly urge boaters to use Channel 9 in these waters. Use of Channel 9 in other waters is optional, and we recommend boaters keep turned to and use Channel 16 in those waters unless otherwise notified by the USCG.
13,67	Navigation Safety (also known as Bridge-to-Bridge channel): Ships greater than 20 m in length maintain a listening watch on this channel in US waters. This channel is available to all ships. Messages must be about ship navigation (i.e., passing or meeting other ships). You must keep your messages short. Your power output must not be more than 1 watt. This is also the main working channel at most locks and drawbridges. Channel 67 is for lower Mississippi River only.
16	International Distress, Safety and Calling: Use this channel to get the attention of another station (calling) or in emergencies. Ships required to carry a radio maintain a listening watch on this channel. USCG and most coast stations also maintain a listening watch on this channel.
21A, 23A, 83A	USCG only.
22A	USCG Liaison and Maritime Safety Information Broadcasts: Announcements of urgent marine information broadcasts and storm warnings (Broadcasts announced on Channel 16).
24,25,26, 27,28,84, 85,86,87	Public Correspondence (Marine Operator): Use these channels to call the marine operator at a public station. By contacting a public coast station, you can make and receive calls from telephones on shore. Except for distress calls, public coast stations usually charge for this service.
70	Digital Selective Calling: Use this channel for distress and safety calling and for general purpose calling using only digital selective calling techniques. Voice communications not allowed. NOTE: The USCG will not be equipped to respond to digital selective calling distress calls on Channel 70 until 2006 – use Channel 16.

Distress Calls

The radiotelephone distress call consists of:

- Distress signal MAYDAY spoken three times
- Words THIS IS
- Call sign (or vessel registration number or name if no call sign is assigned) of the mobile station in distress, spoken three times.

Other electronic gear available is GPS, fathometer, and radar. The user should refer to individual operator manuals for proper orientation in the use of the gear.

9. TOWING AND LAUNCHING

9.1 TRAILERING YOUR BOAT

Choose the proper trailer for your boat. More damage can be done to a boat by the stress of road travel than by normal water operation. A boat hull is designed to be supported evenly by water. When transported on a trailer, your boat should be supported structurally as evenly across the hull as possible. This will allow for even distribution of the weight of the hull, engine and equipment. It should be long enough to support the whole length of the hull but short enough to allow the lower unit of the boat's engine to extend freely.

- Rollers and bolsters must be kept in good condition to prevent scratching and gouging of the hull.

- Tie-downs and lower unit supports must be adjusted properly to prevent the boat from bouncing on the trailer. The bow eye on the boat should be secured with either rope, chain or turnbuckle in addition to the winch cable. Additional straps may be required across the beam of the boat.

- The capacity of the trailer should be greater than the combined weight of the boat, motor, and equipment.

- The tow vehicle must be capable to handling the weight of the trailer, boat, equipment, as well as weight of the passengers and equipment which will be carried inside. This may require that the tow vehicle may need to be specially equipped with an:

  — Engine of adequate power
  — Transmission designed for towing
  — Larger cooling systems for the engine and transmission
  — Heavy duty brakes
  — Load bearing hitch attached to the frame, not the bumper.

Check your vehicle owners manual for specific information.

9.1.1 Check Before You Go Out on the Highway

- The tow ball and coupler are the same size and bolts with washers are tightly secured. (The vibration of road travel can loosen them.)

- The coupler is completely over the ball and the latching mechanism is locked down.

- The trailer is loaded evenly from front to rear as well as side to side. Too much weight on the hitch will cause the rear wheels of the tow vehicle to drag and may make steering more difficult. Too much weight on the rear of the trailer will cause the trailer to "fishtail" and may reduce traction or even lift the rear wheels of the tow vehicle off the ground. The safety chains are attached crisscrossing under the coupler to the frame of the tow vehicle. If the ball were to break, the trailer would follow in a straight line and prevent the coupler from dragging on the road.

- The lights on the trailer function properly.

- Check the brakes. On a level parking area roll forward and apply the brakes several times at increasing speeds to determine a safe stopping distance.

- The side view mirrors are large enough to provide an unobstructed rear view on both sides of the vehicle.

- Check tires (including spare) and wheel bearings. Improper inflation may cause difficulty in steering. When trailer wheels are immersed in water, (especially salt water) the bearings should be inspected and greased after each use.

- Make certain that water from rain or cleaning has been removed from the boat. Water weighs approximately eight pounds per gallon and can add weight that will shift with the movement of the trailer.

9.1.2 Towing Precautions

- Allow more time to brake, accelerate, pass, and stop.

- Remember the turning radius is also much greater, curbs and roadside barriers must be given a wide berth when negotiating corners.

- Prior to operating on the road, practice turning, backing up, etc. on a level, uncongested parking area.

9.1.3 Pre-Launching Preparations

- For the courtesy of others and to prevent rushing, prepare your boat for launching away from the ramp.

- Check the boat to ensure that no damage was caused by the trip.

- Raise the lower unit (remove supports) to proper height for launching so that it will not hit bottom.

- Remove tie-downs and make sure that the winch is properly attached to the bow eye and locked in position.

- Put the drain plug in securely.

- Disconnect the trailer lights to prevent shorting of electrical system or burning out a bulb.

- Attach a line to the bow and the stern of the boat so that the boat cannot drift away after launching and it can be easily maneuvered to a docking area.
- Visually inspect the launch ramp for hazards such as a steep drop off, slippery area, and sharp objects.

- When everything has been double checked, proceed slowly to the ramp remembering that your boat is just resting on the trailer and attached only at the bow. The ideal situation is to have one person in the boat and one observer at the water's edge to help guide the driver of the tow vehicle.

- Keep the rear wheels of the tow vehicle out of the water. This will generally keep the exhaust pipes out of the water. If the exhaust pipes become immersed in the water, the engine may stall.

- Set the parking brake and place tire chocks behind the rear wheels.

- Make sure someone else on shore is holding the lines attached to the boat.

- Lower the motor and prepare to start the engine (after running blowers and checking for fuel leaks).

- Start the boat motor and make sure that water is passing through the engine cooling system.

- Release the winch and disconnect the winch line from the bow when the boat operator is ready.

- At this point, the boat should be able to be launched with a light shove or by backing off the trailer under power. Finish loading your boat at a sufficient distance from the ramp so that others may use it.

9.1.4 Retrieval

The steps for removing your boat from the water are basically the reverse of those taken to launch it. However, keep in mind that certain conditions may exist during retrieval that did not exist during launching. As you approach the takeout ramp, take special care to note such factors as:

- Change in wind direction and/or velocity
- Change in current and/or tide
- Increase in boating traffic
- Visibility, etc.

First, unload the boat at a dock or mooring if possible. Next, maneuver the boat carefully to the submerged trailer, and raise the lower unit of the engine. Then, winch the boat onto the trailer and secure it. Finally, drive the trailer with the boat aboard carefully out of the ramp to a designated parking area for cleanup, reloading, and an equipment safety check. Practice will make launch and retrieval a simple procedure. The best advise is just, “do it cautiously with safety as your main concern.”

9.1.5 Storage

Since your boat may be sitting on its trailer for quite some time before it is used again, it is important that it be stored properly. To avoid damage from sun and weather, cover the boat with a tarp. To remove weight from the wheels, put cinderblocks or wood beams under the tongue and all four corners of the trailer frame.

The safety chains are attached crisscrossing under the coupler to the frame of the tow vehicle. If the ball were to break, the trailer would follow in a straight line and prevent the coupler from dragging on the road.

- The lights on the trailer function properly.

- Check the brakes. On a level parking area, roll forward and apply the brakes several times at increasing speeds to determine a safe stopping distance.

- The side view mirrors are large enough to provide an unobstructed rear view on both sides of the vehicle.

- Check tires (including spare) and wheel bearings. Improper inflation may cause difficulty in steering. When trailer wheels are immersed in water (especially salt water), the bearings should be inspected and greased after each use.

- Make certain that water from rain or cleaning has been removed from the boat. Water weighs approximately 8 lb per gal and can add weight that will shift with the movement of the trailer.

10. OFFSHORE OPERATION SAFETY EQUIPMENT

10.1 EQUIPMENT REQUIREMENTS – VESSEL OPERATING OFFSHORE

If you operate offshore, you should seriously consider carrying additional equipment beyond the minimum federal requirements. This equipment should include appropriate communications gear, an EPIRB, a means of accurately determining your location, and an inflatable life raft. In cold waters, an immersion suit should be carried for everyone on board.

10.1.1 Communications

Carry communications gear, marine VHF-FM, and/or HF transceiver(s), appropriate to your operating area. Cellular phone coverage is available in many coastal areas. However, cellular phones should not be considered a substitute for VHF-FM marine band radios for emergency purposes.

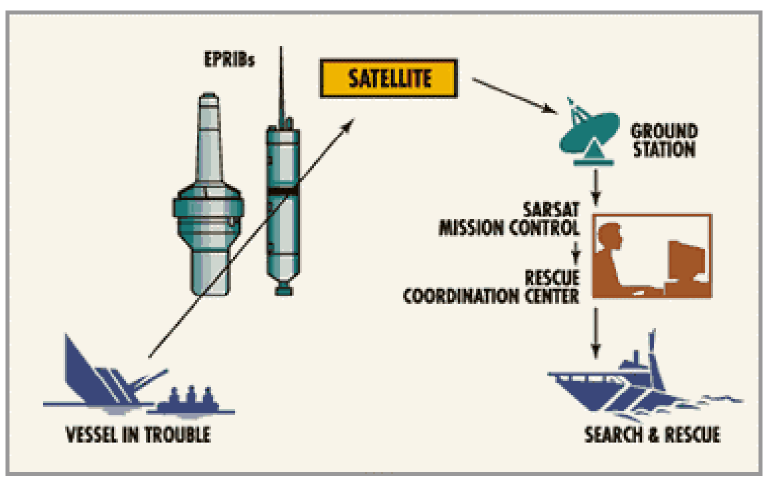
10.1.2 Satellite Emergency Position Indicating Radio Beacons

Satellite EPIRBs (406 MHz) are designed to quickly and reliably alert rescue forces, indicate an accurate distress position, and guide rescue units to the distress scene, even when all other communications fail.

Satellite EPIRBs, operate as part of a worldwide distress system. An international satellite constellation maintains a vigilant, global "listening" watch for satellite EPIRB distress signals. The National Oceanic and Atmospheric Administration operates satellites, ground stations, and an alert distribution system serving the United States and a wide segment of the international community.

When activated, the satellite EPIRB transmits a distress signal with a beacon-unique identifying code. The system detects the signal, calculates an accurate distress position, checks the unique identifying code against the EPIRB registration database (vessel and point-of-contact information supplied by the owner), and routes the distress alert with registration information to the responsible USCG (or international) Rescue Coordination Center, 406 MHz EPIRBs with GPS (internal or attached) also provide an immediate GPS position in the information passed to the Rescue Coordination Center.

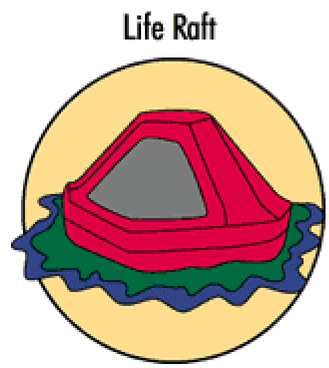
How the System Works



Geostationary satellites make detection almost immediate. If the EPIRB does not have the ability to provide a GPS position, the process to determine a position takes about an hour on average and almost always less than 2 hours. Satellite EPIRBs also include a homing beacon and strobe to help rescue forces quickly locate the distress scene.

Satellite beacons have significant coverage, alerting timeliness, position accuracy, and signaling advantages over other types of EPIRBs (121.5 MHz). Before purchasing or using an other-than-406 MHz EPIRB, be sure you understand its capabilities and limitations.

Mount the EPIRB to float free according to the manufacturer's instructions, if possible. Otherwise, make sure it is **readily accessible. Register** the EPIRB with National Oceanic and Atmospheric Administration, according to the instructions provided with the beacon. Registration is mandatory, improves response, and reduces false alarms.



10.1.3 Inflatable Life Rafts

An inflatable life raft can provide a survival platform for an extended period of time. Make sure the life raft is large enough for everyone on board when the boat operates offshore. It should have the appropriate emergency equipment pack, and should be professionally serviced periodically, according to the manufacturer's instructions. USCG approved life rafts must meet a number of stringent material and performance standards.

10.1.4 Immersion Suits

Immersion suits will delay the effects of hypothermia in cold water. They should be stored and maintained according to the manufacturer's instructions. Table 10-1 provides the required or recommended equipment for the vessel safety check decal.

10.2 ELECTROFISHING FIELD MANUAL

The electrofishing field manual and checklist for a safety and health audit are provided in Appendix C.

TABLE 10-1 REQUIRED OR RECOMMENDED EQUIPMENT FOR THE VESSEL SAFETY CHECK DECAL

Numbering	Proper spacing, contrasting color, minimum 3-in. block letters.
Registration/Documentation	Must be on board.
Navigation Lights	Must operate and show proper configuration.
Sound Producing Device	Horn, whistle, or other; bell on boats over 12 m (39.4 ft) or longer.
Personal Flotation Device	One wearable for each passenger, Type IV on boats 16 ft or longer.
Fire Extinguishers	Minimum for size of boat, HALON, FE241/CO_2-current tag.
Visual Distress Signals	INLAND – Visual Distress Signals, Flag, Signal Light, etc.; INT'L - Minimum flares, aerial rockets, or approved signals, not expired.
Backfire Flame Arrestor	Approved, tight, and clean.
Ventilation	For closed compartments with potential for explosive vapors and an ignition source. Blower must work. Warning Posted. Fuel System tanks secure, over 7 gal considered permanent and must be grounded/vented. Hoses in good condition, no leaks.
Anchor and Tackle	Suitable to boat and the area.
Alternate Propulsion	Under 16 ft, paddle or oar; if mechanical, separate fuel tank and starting source.
Dewatering Device	Pumps must work, extra manual bailer.
Overall Vessel Condition	Bilge and equipment area clean, well maintained. Not overloaded, overpowered, or no automotive parts.
Electrical System	Batteries secure, terminals covered, well organized wiring, proper fuses/circuit breakers.
Galley/Heating Systems	Secure system, proper tank installation. No flammable material nearby.
State Requirements	Compiles with state safety requirements. Contact state boating regulators for current state boating regulations.
Marine Sanitation Device	Approved device, overboard discharge sealed.
MARPOL Trash Placard	Boats 26 ft and longer, written plan over 40 ft.
Pollution Placard	Boats 26 ft and longer with machinery compartment.
Navigation Rules	Boats 12 m (39.4 ft) and longer.

11. CHECKLISTS

11.1 EQUIPMENT REQUIREMENTS – SAFETY AND SURVIVAL TIPS

Boater's Checklist	**Yes**	**No**
State Numbering Displayed		
Certificate of Number (State Registration)		
Certificate of Documentation/Display		
Official Number Displayed		
Personal Flotation Devices		
Throwable Personal Flotation Device		
Visual Distress Signals		
Fire Extinguishers		
Ventilation		
Backfire Flame Arrester		
Sound Producing Device		
Bell		
Navigation/Anchor Lights		
Oil Pollution Placard		
Garbage Placard		
Marine Sanitation Device		
Ring Buoy[(a)]		
VHF Radio[(a)]		
Heaving Line[(a)]		
Fenders[(a)]		
First Aid Kit[(a)]		
Flashlight[(a)]		
Mirror[(a)]		
Search Light[(a)]		
Tool Kit[(a)]		
Chart and Compass[(a)]		
Boat Hook[(a)]		
Spare Propeller[(a)]		
Mooring Line[(a)]		
Food and Water[(a)]		
Binoculars[(a)]		
Spare Batteries[(a)]		
Marine Hardware[(a)]		
Sunscreen (SPF 30+)[(a)]		
Extra Clothing[(a)]		
Spare Parts[(a)]		
Spare Fuel[(a)]		
AM-FM Radio[(a)]		
Anchor and Tackle[(a)]		
Dewatering Device[(a)]		
Alternate Propulsion[(a)]		
Overall Boat Condition[(a)]		
Electrical Systems[(a)]		
Fuel Systems[(a)]		
Galley/Heating Systems[(a)]		
State Safety Requirements[(a)]		
File Float Plan[(a)]		
Weather Forecast[(a)]		
(a) Recommended.		

11.2 SMALL CRAFT INSPECTION LIST

	Yes	No
Maintenance Records		
Hull Soundness		
Metal Visual Cracks/Date of Last Ultrasound		
Wood Rot and Loose Planking		
Fiberglass Stress Cracks and Delamination		
Soundness of Deck and Superstructure		
Standing Rigging and Frames		
Stays		
Cleats		
Bits		
Shackles		
Thimbles		
Lines		
Running Rigging		
Lines		
Shackles		
Blocks		
Thimbles		
Engine Compartment		
Belts		
Hoses		
Fuel Lines		
Seacocks		
Bilge Blowers		
Deck Machinery		
Hydraulics		
Wire		
Winches		
OSHA and EA Requirements		

11.3 TRAILER CHECKLIST

Trailer Checklist – Prior to On-Road/Boat Retrieval	**Yes**	**No**
Vehicle is appropriate for trailering weight of trailer and boat (e.g., pickup, suburban, or similar)		
Trailer is appropriate for boat		
Tow ball and light system are in good working order		
Safety chains are in good working order		
Vessel tie-downs (if needed) are attached to trailer		
Trailer lights operate (brake and turn signals)		
If outboard engine, engine is in secured up position		
Trailer tires are inflated and suspension in good working order		
Trailer Checklist – Pre-Launch		
Ensure drain plugs are in position		
Trailer lights are disconnected		
Tie-downs removed		
Line attached to bow and is tended		
Inspect ramp for hazards, steep drops, etc.		
Ensure engine starts and cooling system are properly working		

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Appendix A

Nautical Terms

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APPENDIX A

NAUTICAL TERMS

A	
ABAFT	Toward the rear (stern) of the boat; behind.
ABEAM	At right angles to the keel of the boat, but not on the boat.
ABOARD	On or within the boat.
ABOVE DECK	On the deck (not over it – see ALOFT).
AFT	Toward the stern of the boat.
AGROUND	Touching or fast to the bottom.
AHEAD	In a forward direction.
AIDS TO NAVIGATION	Artificial objects to supplement natural landmarks to indicate safe and unsafe waters.
ALOFT	Above the deck of the boat.
AMIDSHIPS	In or toward the center of the boat.
ANCHOR	A heavy metal device, fastened to a chain or line, to hold a vessel in position, partly because of its weight, but chiefly because the designed shape digs into the bottom.
ANCHORAGE	A place suitable for anchoring in relation to the wind, seas, and bottom.
ASTERN	In back of the boat, opposite of ahead.
ATHWARTSHIPS	At right angles to the centerline of the boat; rowboat seats are generally athwartships.
B	
BATTEN DOWN	Secure hatches and loose objects both within the hull and on deck.
BEACON	A lighted or unlighted fixed aid to navigation attached directly to the earth's surface (lights and day beacons both constitute "beacons").
BEAM	The greatest width of the boat.
BEARING	The direction of an object expressed either as a true bearing as shown on the chart, or as a bearing relative to the heading of the boat.
BELOW	Beneath the deck.
BIGHT	The part of the rope or line between the end and the standing part on which a knot is formed. A shallow bay.
BILGE	The interior of the hull below the floor boards.
BITTER END	The last part of a rope or chain. The inboard end of the anchor rode.
BLOCK	A wooden or metal case enclosing one or more pulleys and having a hook, eye, or strap by which it may be attached.
BOAT	A fairly indefinite term. A waterborne vehicle smaller than a ship. One definition is a small craft carried aboard a ship.
BOAT HOOK	A short shaft with a fitting at one end shaped to facilitate use in putting a line over a piling, recovering an object dropped overboard, or in pushing or fending off.
BOW	The forward part of a boat.
BOW LINE	A docking line leading from the bow.
BOW SPRING LINE	A bow pivot line used in docking and undocking, or to prevent the boat from moving forward or astern while made fast to a pier.
BOWLINE KNOT	A knot used to form a temporary loop in the end of a line.
BOWSPRIT	A spar extending forward from the bow.
BRIDGE	The location from which a vessel is steered and its speed controlled. "Control Station" is really a more appropriate term for small craft.
BULKHEAD	A vertical partition separating compartments.

BUOY	An anchored float used for marking a position on the water or a hazard or a shoal and for mooring.
C	
CABIN	A compartment for passengers or crew.
CAPSIZE	To turn over.
CAST OFF	To let go.
CATAMARAN	A twin-hulled boat, with hulls side-by-side.
CHAFING GEAR	Tubing or cloth wrapping used to protect a line from chafing on a rough surface.
CHANNEL	1. That part of a body of water deep enough for navigation through an area otherwise not suitable. It is usually marked by a single or double line of buoys and sometimes by range markers. 2. The deepest part of a stream, bay, or strait through which the main current flows. 3. A name given to a large strait, for example, the English Channel.
CHART	A map for use by navigators.
CHINE	The intersection of the bottom and sides of a flat or v-bottomed boat.
CHOCK	A fitting through which anchor or mooring lines are led. Usually U-shaped to reduce chafe.
CLEAT	A fitting to which lines are made fast. The classic cleat to which lines are belayed is approximately anvil-shaped.
CLOVE HITCH	A knot for temporarily fastening a line to a spar or piling.
COAMING	A vertical piece around the edge of a cockpit, hatch, etc. to prevent water on deck from running below.
COCKPIT	An opening in the deck from which the boat is handled.
COIL	To lay a line down in circular turns.
COMPASS	Navigation instrument, either magnetic (showing magnetic north) or gyro (showing true north).
COMPASS CARD	Part of a compass, the card is graduated in degrees, to conform with the magnetic meridian-referenced direction system inscribed with direction which remains constant; the vessel turns, not the card.
COMPASS ROSE	The resulting figure when the complete 360° directional system is developed as a circle with each degree graduated upon it, and with the 000° indicated as True North. True North is also known as true rose. This is printed on nautical charts for determining direction.
CURRENT	The horizontal movement of water.
D	
DAYBEACON	A fixed navigation aid structure used in shallow waters upon which is placed one or more daymarks.
DAYMARK	A signboard attached to a daybeacon to convey navigational information presenting one of several standard shapes (square, triangle, rectangle) and colors (red, green, orange, yellow, or black). Daymarks usually have reflective material indicating the shape, but may also be lighted.
DEAD AHEAD	Directly ahead.
DEAD ASTERN	Directly aft or behind.
DEAD RECKONING	A plot of courses steered and distances traveled through the water.
DECK	A permanent covering over a compartment, hull, or any part of a ship serving as a floor.
DISPLACEMENT	The weight of water displaced by a floating vessel.
DISPLACEMENT HULL	A type of hull that plows through the water, displacing a weight of water equal to its own weight, even when more power is added.

DOCK	A protected water area in which vessels are moored. The term is often used to denote a pier or a wharf.
DRAFT	The depth of water a boat draws.
E	
EASE	To slacken or relieve tension on a line.
EBB TIDE	A receding tide.
EVEN KEEL	When a boat is floating on its designed waterline, it is said to be floating on an even keel.
EYE OF THE WIND	The direction from which the wind is blowing.
EYE SPLICE	A permanent loop spliced in the end of a line.
F	
FAST	Said of an object that is secured to another.
FATHOM	6 ft.
FENDER	A cushion, placed between boats, or between a boat and a pier, to prevent damage.
FIGURE EIGHT KNOT	A knot in the form of a figure eight, placed in the end of a line to prevent the line from passing through a grommet or a block.
FLAME ARRESTER	A safety device, such as a metal mesh protector, to prevent an exhaust backfire from causing an explosion; operates by absorbing heat.
FLARE	The outward curve of a vessel's sides near the bow. A distress signal.
FLYING BRIDGE	An added set of controls above the level of the normal control station for better visibility. Usually open, but may have a collapsible top for shade.
FOLLOWING SEA	An overtaking sea that comes from astern.
FORE AND AFT	In a line parallel to the keel.
FORWARD	Toward the bow of the boat.
FOULED	Any piece of equipment that is jammed or entangled, or dirtied.
FOUNDER	When a vessel fills with water and sinks.
FREEBOARD	The minimum vertical distance from the surface of the water to the gunwale.
G	
GAFF	A spar to support the head of a gaff sail.
GALLEY	The kitchen area of a boat.
GANGWAY	The area of a ship's side where people board and disembark.
GEAR	A general term for ropes, blocks, tackle, and other equipment.
GIVE-WAY VESSEL	A term, from the Navigational Rules, used to describe the vessel which must yield in meeting, crossing, or overtaking situations.
GRAB RAILS	Hand-hold fittings mounted on cabin tops and sides for personal safety when moving around the boat.
GROUND TACKLE	Anchor, anchor rode (line or chain), and all the shackles and other gear used for attachment.
GUNWALE	The upper edge of a boat's sides.
H	
HARBOR	A safe anchorage, protected from most storms; may be natural or man-made, with breakwaters and jetties; a place for docking and loading.
HATCH	An opening in a boat's deck fitted with a watertight cover.
HEAD	A marine toilet. Also the upper corner of a triangular sail.
HEADING	The direction in which a vessel's bow points at any given time.
HEADWAY	The forward motion of a boat. Opposite of sternway.
HEAVE TO	To bring a vessel up in a position where it will maintain little or no headway, usually with the bow into the wind or nearly so.

HEEL	To tip to one side.
HELM	The wheel or tiller controlling the rudder.
HITCH	A knot used to secure a rope to another object or to another rope, or to form a loop or a noose in a rope.
HOLD	A compartment below deck in a large vessel, used solely for carrying cargo.
HULL	The main body of a vessel.
HYPOTHERMIA	A life-threatening condition in which the body's warming mechanisms fail to maintain normal body temperature and the entire body cools.
I	
INBOARD	More toward the center of a vessel; inside; a motor fitted inside the boat.
J	
There are no boating terms under this heading.	
K	
KEDGE	To use an anchor to move a boat by hauling on the anchor rode; a basic anchor type.
KEEL	The centerline of a boat running fore and aft; the backbone of a vessel.
KETCH	A two-masted sailboat with the smaller after mast stepped ahead of the rudder post.
KNOT	A measure of speed equal to one nautical mile (6,076 ft) per hour. A fastening made by interweaving rope to form a stopper, to enclose or bind an object, to form a loop or a noose, to tie a small rope to an object, or to tie the ends of two small ropes together.
L	
LEEWARD	The direction away from the wind. Opposite of windward.
LEEWAY	The sideways movement of the boat caused by either wind or current.
LINE	Rope and cordage used aboard a vessel.
LOG	A record of courses or operation. Also, a device to measure speed.
LUBBER'S LINE	A mark or permanent line on a compass indicating the direction forward; parallel to the keel when properly installed.
M	
MAST	A spar set upright to support rigging and sails.
MONOHULL	A boat with one hull.
MOORING	An arrangement for securing a boat to a mooring buoy or a pier.
MOORING BUOY	A buoy secured to a permanent anchor sunk deeply into the bottom.
N	
NAUTICAL MILE	One minute of latitude; approximately 6,076 ft – about 1/8 longer than the statute mile of 5,280 ft.
NAVIGATION	The art and science of conducting a boat safely from one point to another.
O	
OUTBOARD	Toward or beyond the boat's sides. A detachable engine mounted on a boat's stern.
OUTDRIVE	A propulsion system for boats with an inboard engine operating an exterior drive, with drive shaft, gears, and propeller; also called stern-drive and inboard/outboard.
OVERBOARD	Over the side or out of the boat.
P	
PAINTER	A line attached to the bow of a boat for use in towing or making fast.
PAY OUT	To ease out a line, or let it run in a controlled manner.

PENNANT (sometimes PENDANT)	The line by which a boat is made fast to a mooring buoy.
PERSONAL FLOTATION DEVICE	Personal flotation device (PFD) is official terminology for life jacket. When properly used, the PFD will support a person in the water. Available in several sizes and types.
PIER	A loading/landing platform extending at an angle from the shore.
PILOTING	Navigation by use of visible references, the depth of the water, etc.
PITCH	1. The alternate rise and fall of the bow of a vessel proceeding through waves. 2. The theoretical distance advanced by a propeller in one revolution. 3. Tar and resin used for caulking between the planks of a wooden vessel.
PITCHPOLING	A small boat being thrown end-over-end in very rough seas.
PLANING HULL	A type of hull shaped to glide easily across the water at high speed.
PORT	The left side of a boat looking forward. A harbor.
PROPELLER	A rotating device, with two or more blades, that acts as a screw in propelling a vessel.
Q	
QUARTER	The sides of a boat aft of amidships.
QUARTERING SEA	Sea coming on a boat's quarter.
R	
REEF	To reduce the sail area.
RIGGING	The general term for all the lines of a vessel.
RODE	The anchor line and/or chain.
ROLL	The alternating motion of a boat, leaning alternately to port and starboard; the motion of a boat about its fore-and-aft axis.
ROPE	In general, cordage as it is purchased at the store. When it comes aboard a vessel and is put to use, it becomes a line.
RUDDER	A vertical plate or board for steering a boat.
RUNNING LIGHTS	Lights required to be shown on boats underway between sundown and sunup.
S	
SCOPE	The ratio of the length of an anchor line, from a vessel's bow to the anchor, to the depth of the water.
SCREW	A boat's propeller.
SEA ANCHOR	Any device used to reduce a boat's drift before the wind.
SECURE	To make fast.
SHACKLE	A U-shaped connector with a pin or bolt across the open end.
SHEAR PIN	A safety device used to fasten a propeller to its shaft; it breaks when the propeller hits a solid object, thus preventing further damage.
SHEET BEND	A knot used to join two ropes. Functionally different from a square knot in that it can be used between lines of different diameters.
SHIP	A larger vessel usually used for ocean travel. A vessel able to carry a "boat" on board.
SHOAL	An offshore hazard to navigation at a depth of 16 fathoms (30 meters or 96 ft) or less, composed of unconsolidated material.
SLACK	Not fastened; loose. Also, to loosen.
SLOOP	A single masted vessel with working sails (main and jib) set fore and aft.
SPLICE	To permanently join two ropes by tucking their strands alternately over and under each other.
SPRING LINE	A pivot line used in docking, undocking, or to prevent the boat from moving forward or astern while made fast to a dock.

SQUALL	A sudden, violent wind often accompanied by rain.
SQUARE KNOT	A knot used to join two lines of similar size. Also called a reef knot.
STANDING PART	That part of a line which is made fast. The main part of a line as distinguished from the bight and the end.
STAND-ON VESSEL	That vessel which continues its course in the same direction at the same speed during a crossing or overtaking situation, unless a collision appears imminent (was formerly called "the privileged vessel").
STARBOARD	The right side of a boat when looking forward.
STERN	The after part (back) of the boat.
STERN LINE	A docking line leading away from the stern.
STOW	To pack or store away; especially, to pack in an orderly, compact manner.
SWAMP	To fill with water, but not settle to the bottom.
T	
TACKLE	A combination of blocks and line to increase mechanical advantage.
THWART	A seat or brace running laterally across a boat.
TIDE	The periodic rise and fall of water level in the oceans.
TILLER	A bar or handle for turning a boat's rudder or an outboard motor.
TOPSIDES	The sides of a vessel between the waterline and the deck; sometimes referring to onto or above the deck.
TRANSOM	The stern cross-section of a square-sterned boat.
TRIM	Fore and aft balance of a boat.
TRIMARAN	A boat with three hulls.
TRIPLINE	A line fast to the crown of an anchor by means of which it can be hauled out when dug too deeply or fouled; a similar line used on a sea anchor to bring it aboard.
TRUE NORTH POLE	The north end of the earth's axis. Also called North Geographic Pole. The direction indicated by 000° (or 360°) on the true compass rose.
TRUE WIND	The actual direction from which the wind is blowing.
TURNBUCKLE	A threaded, adjustable rigging fitting, used for stays, lifelines, and sometimes other rigging.
U	
UNDERWAY	Vessel in motion, i.e., when not moored, at anchor, or aground.
V	
V BOTTOM	A hull with the bottom section in the shape of a "V."
VARIATION	The angular difference between the magnetic meridian and the geographic meridian at a particular location.
VHF RADIO	A very high frequency electronic communications and direction finding system.
W	
WAKE	Moving waves, track, or path that a boat leaves behind when moving across the waters.
WATERLINE	A line painted on a hull which shows the point to which a boat sinks when it is properly trimmed.
WAY	Movement of a vessel through the water, such as headway, sternway, or leeway.
WHARF	A man-made structure bonding the edge of a dock and built along or at an angle to the shoreline, used for loading, unloading, or tying up vessels.
WINCH	A device used to increase hauling power when raising or trimming sails.
WINDWARD	Toward the direction from which the wind is coming. Opposite of leeward.

X	
There are no boating terms under this heading.	
Y	
YAW	To swing off course, as when due to the impact of a following or quartering sea.
YAWL	A two-masted sailboat with the small mizzen mast stepped abaft the rudder post.
Z	
There are no boating terms under this heading.	

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Appendix B

"Rules of the Water"

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APPENDIX B

"RULES OF THE WATER"

PART A – GENERAL

Rule 1—Application

(a) These Rules shall apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels.

(b) Nothing in these Rules shall interfere in the operation of special rules made by an appropriate authority for roadsteads, harbors, rivers, lakes, or inland waterways connected with the high seas and navigable by seagoing vessels. Such special rules shall conform as closely as possible to these Rules.

(c) Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any State with respect to additional station or signal lights or shapes or whistle signals for ships of war and vessels proceeding under convoy, or with respect to additional station or signal lights for fishing vessels fishing as a fleet. These additional station or signal lights or whistle signals shall, so far as possible, be such that they cannot be mistaken for any light, shape, or signal authorized elsewhere under these Rules.

(d) Traffic separation schemes may be adopted by the Organization for the purpose of these Rules.

(e) Whenever the Government concerned shall have determined that a vessel of special construction or purpose cannot comply fully with the provisions of any of these Rules with respect to number, position, range, or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signaling appliances, such vessel shall comply with such other provisions in regard to number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signaling appliances, as her Government shall have determined to be the closest possible compliance with these Rules in respect to that vessel.

Rule 2—Responsibility

(a) Nothing in these Rules shall exonerate any vessel, or the owner, master, or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(b) In construing and complying with these Rules, due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

Rule 3—General Definitions

For the purpose of these Rules, except where the context otherwise requires:

(a) The word "vessel" includes every description of watercraft, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.

(b) The term "power driven vessel" means any vessel propelled by machinery.

(c) The term "sailing vessel" means any vessel under sail provided that propelling machinery, if fitted, is not being used.

(d) The term "vessel engaged in fishing" means any vessel fishing with nets, lines, trawls, or other fishing apparatus which restrict maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manageability.

(e) The term "seaplane" includes any aircraft designed to maneuver on the water.

(f) The term "vessel not under command" means a vessel which through some exceptional circumstance is unable to maneuver as required by these Rules and is, therefore, unable to keep out of the way of another vessel.

(g) The term "vessel restricted in her ability to maneuver" means a vessel which from the nature of her work is restricted in her ability to maneuver as required by these Rules and is, therefore, unable to keep out of the way of another vessel. The term "vessel restricted in her ability to maneuver" shall include but not be limited to:

- (i) A vessel engaged in laying, servicing, or picking up a navigational mark, submarine cable, or pipeline
- (ii) A vessel engaged in dredging, surveying, or underwater operations
- (iii) A vessel engaged in replenishment or transferring persons, provisions, or cargo while underway
- (iv) A vessel engaged in the launching or recovery of aircraft
- (v) A vessel engaged in mine clearance operations
- (vi) A vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.

(h) The term "vessel constrained by her draft" means a power-driven vessel which because of her draft in relation to the available depth and width of navigable water is severely restricted in her ability to deviate from the course she is following.

(i) The word "underway" means a vessel is not at anchor, or made fast to the shore, or aground.

(j) The words "length" and "breadth" of a vessel mean her length overall and greatest breadth.

(k) Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other.

(l) The term "restricted visibility" means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms, and any other similar causes.

PART B – STEERING AND SAILING RULES

Section I – Conduct of Vessels in any Condition of Visibility

Rule 4—Application

Rules in this section apply to any condition of visibility.

Rule 5—Look-Out

Every vessel shall at all times maintain a proper look-out by sight as well as by hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

Rule 6—Safe Speed

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed, the following factors shall be among those taken into account:

(a) By all vessels:

- (i) The state of visibility
- (ii) The traffic density including concentrations of fishing vessels or any other vessels
- (iii) The manageability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions
- (iv) At night the presence of background light such as from shore lights or from back scatter from her own lights
- (v) The state of wind, sea, and current, and the proximity of navigational hazards
- (vi) The draft in relation to the available depth of water.

(b) Additionally, by vessels with operational radar:

- (i) The characteristics, efficiency, and limitations of the radar equipment
- (ii) Any constrains imposed by the radar range scale in use
- (iii) The effect on radar detection of the sea state, weather, and other sources of interference
- (iv) The possibility that small vessels, ice, and other floating objects may not be detected by radar at an adequate range
- (v) The number location and movement of vessels detected by radar
- (vi) The more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

Rule 7—Risk of Collision

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt, such risk shall be deemed to exist.

(b) Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

(c) Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

(d) In determining if risk of collision exists, the following considerations shall be among those taken into account:

(i) Such risk shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change.
(ii) Such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when approaching a vessel at close range.

Rule 8—Action to Avoid Collision

(a) Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed shall be avoided.

(c) If there is sufficient sea room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.

(d) Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.

(e) If necessary to avoid collision or allow more time to assess the situation, a vessel may slacken her speed or take all the way off by stopping or reversing her means of propulsion.

(f) (i) A vessel which, by any of these rules, is required not to impede the passage or safe passage of another vessel shall, when required by the circumstances of the case, take early action to allow sufficient sea room for the safe passage of the other vessel.
(ii) A vessel required not to impede the passage or safe passage of another vessel is not relieved of this obligation if approaching the other vessel so as to involve risk of collision and shall, when taking action, have full regard to the action which may be required by the rules of this part.
(iii) A vessel, the passage of which is not to be impeded, remains fully obliged to comply with the rules of this part when the two vessels are approaching one another so as to involve risk of collision.

Rule 9—Narrow Channels

(a) A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.

(b) A vessel of less than 20 m in length or a sailing vessel shall not impede the passage of a vessel which can safely navigate only within a narrow channel or fairway.

(c) A vessel engaged in fishing shall not impede the passage of any other vessel navigating within a narrow passage or fairway.

(d) A vessel shall not cross a narrow passage or fairway if such crossing impedes the passage of a vessel which can safely navigate only within such channel or fairway. The latter vessel may use the sound signal prescribed in Rule 34(d) if in doubt as to the intention of the crossing vessel.

(e) (i) In a narrow channel or fairway when overtaking can take place only when the vessel to be overtaken has to take action to permit safe passing, the vessel intending to overtake shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c)(i). The vessel to be overtaken shall, if in agreement, sound the appropriate signal prescribed in Rule 34(c)(ii) and take steps to permit safe passing. If in doubt, she may sound the signals prescribed in Rule 34(d).
(ii) This rule does not relieve the overtaking vessel of her obligation under Rule 13.

(f) A vessel nearing a bend or an area of a narrow channel or fairway where other vessels may be obscured by an intervening obstruction shall navigate with particular alertness and caution and shall sound the appropriate signal prescribed in Rule 34(e).

(g) Any vessel shall, if the circumstances of the case admit, avoid anchoring in a narrow channel.

Rule 10—Traffic Separation Schemes

(a) This rule applies to traffic separation schemes adopted by the Organization and does not relieve any vessel of her obligation under any other rule.

(b) A vessel using a traffic separation scheme shall:

(i) Proceed in the appropriate traffic lane in the general direction of traffic flow for that lane.
(ii) So far as is practicable keep clear of a traffic separation line or separation zone.
(iii) Normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.

(c) A vessel shall so far as practicable avoid crossing traffic lanes, but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.

(d) (i) A vessel shall not use an inshore traffic zone when she can safely use the appropriate traffic lane within the adjacent traffic separation scheme. However, vessels of less than 20 m in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.
(ii) Notwithstanding subparagraph (d)(i), a vessel may use an inshore traffic Zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.

(e) A vessel, other than a crossing vessel or a vessel joining or leaving a lane shall not normally enter a separation zone or cross a separation line except:

(i) in cases of emergency to avoid immediate danger
(ii) to engage in fishing within a separation zone.

(f) A vessel navigating in areas near the terminations of traffic separation schemes shall do so with particular caution.

(g) A vessel shall so far as practicable avoid anchoring in a traffic separation scheme or in areas near its terminations.

(h) A vessel not using a traffic separating scheme shall avoid it by as wide a margin as is practicable.

(i) A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

(j) A vessel of less than 20 m in length or a sailing vessel shall not impede the safe passage of a power driven vessel following a traffic lane.

(k) A vessel restricted in her ability to maneuver when engaged in an operation for the maintenance of safety of navigation in a traffic separating scheme is exempted from complying with this Rule to the extent necessary to carry out the operation.

(l) A vessel restricted in her ability to maneuver when engaged in an operation for the laying, servicing or picking up a submarine cable, within a traffic separating scheme, is exempted from complying with this Rule to the extent necessary to carry out the operation.

Section II – Conduct of Vessels in Sight of One Another

Rule 11—Application

Rules in this section apply to vessels in sight of one another.

Rule 12—Sailing Vessels

(a) When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

  (i) When each of them has the wind on a different side, the vessel which has the wind on the port side shall keep out of the way of the other
  (ii) When both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward
  (iii) If the vessel with the wind on the port side sees a vessel to windward and cannot determine with certainty whether the other vessel has the wind on the port or the starboard side, she shall keep out of the way of the other.

(b) For the purposes of this Rule the windward side shall be deemed to be the side opposite that on which the mainsail is carried or, in the case of a square rigged vessel, the side opposite to that on which the largest fore-and-aft sail is carried.

Rule 13—Overtaking

(a) Notwithstanding anything contained in the Rules of Part B, Sections I and II, any vessel overtaking any other shall keep out of the way of the vessel being overtaken.

(b) A vessel shall be deemed to be overtaking when coming up with a another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the sternlight of that vessel but neither of her sidelights.

(c) When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.

(d) Any subsequent alteration of the bearing between the two vessels shall not make the overtaking vessel a crossing vessel within the meaning of these Rules or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

Rule 14—Head-On Situation

(a) When two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision, each shall alter her course to starboard so that each shall pass on the port side of the other.

(b) Such a situation shall be deemed to exist when a vessel sees the other ahead or nearly ahead and by night she could see the masthead lights in line or nearly in line and/or both sidelights and by day she observes the corresponding aspect of the other vessel.

(c) When a vessel is in any doubt as to whether such a situation exists, she shall assume that it does exist and act accordingly.

Rule 15—Crossing Situation

When two power-driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

Rule 16—Action by Give-way Vessel

Every vessel which is directed to keep out of the way of another vessel shall, so far as possible, take early and substantial action to keep well clear.

Rule 17—Action by Stand-on Vessel

(a) (i) Where one of two vessels is to keep out of the way of the other shall keep her course and speed.
(ii) The latter vessel may, however, take action to avoid collision by her maneuver alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in accordance with these Rules.

(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

(c) A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.

(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

Rule 18—Responsibilities between Vessels

Except where Rules 9, 10, and 13 otherwise require:

(a) A power driven vessel underway shall keep out of the way of:

- (i) a vessel not under command
- (ii) a vessel restricted in her ability to maneuver
- (iii) a vessel engaged in fishing
- (iv) a sailing vessel

(b) A sailing vessel under way shall keep out of the way of:

- (i) a vessel not under command
- (ii) a vessel restricted in her ability to maneuver
- (iii) a vessel engaged in fishing

(c) A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of:

- (i) a vessel not under command
- (ii) a vessel restricted in her ability to maneuver.

(d) (i) Any vessel other than a vessel not under command or a vessel restricted in her ability to maneuver shall, if the circumstances of the case admit, avoid impeding the safe passage of a vessel constrained by her draft, exhibiting the signals in Rule 28.
(ii) A vessel constrained by her draft shall navigate with particular caution having full regard to her special condition.

(e) A seaplane on the water shall, in general, keep well clear of all vessels and avoid impeding their navigation. In circumstances, however, where risk of collision exists, she shall comply with the Rules of this Part.

Section III – Conduct of Vessels in Restricted Visibility

Rule 19—Conduct of Vessels in Restricted Visibility

(a) This rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and condition of restricted visibility. A power-driven vessel shall have her engines ready for immediate maneuver.

(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of Section I of this Part.

(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration in course, so far as possible the following shall be avoided:

(i) An alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken
(ii) An alteration of course toward a vessel abeam or abaft the beam.

(e) Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to be the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

PART C – LIGHTS AND SHAPES

Rule 20—Application

(a) Rules in this part shall be complied with in all weathers.

(b) The Rules concerning lights shall be complied with from sunset to sunrise, and during such times no other lights shall be exhibited, except such lights which cannot be mistaken for the lights specified in these Rules or do not impair their visibility or distinctive character, or interfere with the keeping of a proper look-out.

(c) The lights prescribed by these rules shall, if carried, also be exhibited from sunrise to sunset in restricted visibility and may be exhibited in all other circumstances when it is deemed necessary.

(d) The Rules concerning shapes shall be complied with by day.

(e) The lights and shapes specified in these Rules shall comply with the provisions of Annex I to these Regulations.

Rule 21—Definitions

(a) ”Masthead light” means a white light placed over the fore and aft centerline of the vessel showing an unbroken light over an arc of horizon of 225 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the vessel.

(b) "Sidelights" means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of horizon of 112.5 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on the respective side. In a vessel of less than 20 m in length the sidelights may be combined in one lantern carried on the fore and aft centerline of the vessel.

(c) "Stern light," means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of horizon of 135 degrees and so fixed as to show the light 67.5 degrees from right aft on each side of the vessel.

(d) "Towing light" means a yellow light having the same characteristics as the "stern light" defined in paragraph (c) of this Rule.

(e) "All round light" means a light showing an unbroken light over an arc of horizon of 360 degrees.

(f) "Flashing light" means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.

Rule 22—Visibility of Lights

The lights prescribed in these Rules shall have an intensity as specified in Section 8 of Annex I to these Regulations so as to be visible at the following minimum ranges:

(a) In vessels of 50 m or more in length:
- A masthead light, 6 mi
- A sidelight, 3 mi
- A towing light, 3 mi
- A white, red, green, or yellow all-around light, 3 mi.

(b) In vessels of 12 m or more in length but less than 50 m in length
- A masthead light, 5 mi; except that where the length of the vessel is less than 20 m, 3 mi
- A sidelight, 2 mi
- A stern light, 2 mi, A towing light, 2 mi
- A white, red, green or yellow all-round light, 2 mi.

(c) In vessels of less than 12 m in length:
- A masthead light, 2 mi
- A sidelight, 1 mi
- A towing light, 2 mi
- A white, red, green, or yellow all-around light, 2 mi.

(d) In inconspicuous, partly submerged vessels or objects being towed
- A white all-round light; 3 mi.

Rule 23—Power-Driven Vessels Underway

(a) A power-driven vessel underway shall exhibit:

(i) A masthead light forward
(ii) A second masthead light abaft of and higher than the forward one; except that a vessel of less than 50 m in length shall not be obliged to exhibit such a light but may do so;
(iii) Sidelights
(iv) A stern light.

(b) An air-cushion vessel when operating in non-displacement mode shall, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit an all-round flashing yellow light.

(c) (i) A power-driven vessel of less than 12 m in length may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and sidelights.
(ii) A power-driven vessel of less than 7 m in length whose maximum speed does not exceed 7 knots may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light and shall, if practicable, also exhibit sidelights.

(iii) The masthead light or all-round white light on a power-driven vessel of less than 12 m in length may be displaced from the fore and aft centerline of the vessel if centerline fitting is not practicable, provided the sidelights are combined in one lantern which shall be carried on the fore and aft centerline of the vessel or located as nearly as practicable in the same fore and aft line as the masthead light or all-round white light.

Rule 24—Towing and Pushing

(a) A power driven vessel when towing shall exhibit:

(i) Instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line. When the length of the tow measuring from the stern of the towing vessel to the after end of the tow exceeds 200 m, three such lights in a vertical line
(ii) Sidelights
(iii) A stern light
(iv) A towing light in a vertical line above the stern light
(v) When the length of the tow exceeds 200 m, a diamond shape where it can best be seen.

(b) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and exhibit the lights prescribed in Rule 23.

(c) A power-driven vessel when pushing ahead or towing alongside, except in the case of a composite unit, shall exhibit:

(i) Instead of the light prescribed in Rule 23(a)(i) or (a)(ii), two masthead lights in a vertical line. When the length of the tow measuring from the stern of the towing vessel to the after end of the tow exceeds 200 m, three such lights in a vertical line
(ii) Sidelights
(iii) A stern light.

(d) A power-driven vessel to which paragraph (a) or (c) of this Rule apply shall also comply with rule 23(a)(ii).

(e) A vessel or object being towed, other than those mentioned in paragraph (g) of this Rule, shall exhibit:

(i) Sidelights
(ii) A stern light
(iii) When the length of the tow exceeds 200 m, a diamond shape where it can best be seen.

(f) Provided that any number of vessels being towed alongside or pushed in a group shall be lighted as one vessel,

(i) A vessel being pushed ahead, not being part of a composite unit, shall exhibit at the forward end, sidelights
(ii) A vessel being towed alongside shall exhibit a stern light and at the forward end, sidelights.

(g) An inconspicuous, partly submerged vessel or object, or combination of such vessels or objects being towed, shall exhibit:

- (i) If it is less than 25 m in breadth, one all-round white light at or near the front end and one at or near the after end except that dracones need not exhibit a light at or near the forward end
- (ii) If it is 25 m or more in breadth, two or more additional all-round white lights at or near the extremities of its breadth
- (iii) If it exceeds 100 m in length, additional all-round white lights between the lights prescribed in subparagraphs (i) and (ii) so that the distance between the lights shall not exceed 100 m.
- (iv) A diamond shape at or near the aftermost extremity of the last vessel or object being towed and if the length of the tow exceeds 200 m an additional diamond shape where it can best be seen and located as far forward as is practicable.

(h) When from any sufficient cause it is impracticable for a vessel or object being towed to exhibit the lights or shapes prescribed in paragraph (e) or (g) of this Rule, all possible measures shall be taken to light the vessel or object being towed or at least indicate the presence of such vessel or object.

(i) Where from any sufficient cause it is impracticable for a vessel not normally engaged in towing operations to display the lights prescribed in paragraph (a) or (c) of this Rule, such vessel shall not be required to exhibit those lights when engaged in towing another vessel in distress or otherwise in need of assistance. All possible measures shall be taken to indicate the nature of the relationship between the towing vessel and the vessel being towed as authorized by Rule 36, in particular by illuminating the towline.

Rule 25—Sailing Vessels Underway and Vessels Under Oars

(a) A sailing vessel underway shall exhibit:

- (i) Sidelights
- (ii) A stern light.

(b) In a sailing vessel of less than 20 m in length the lights prescribed in paragraph (a) of this Rule may be combined in one lantern carried at or near the top of the mast where it can best be seen.

(c) A sailing vessel underway may, in addition to the lights prescribed in paragraph (a) of this Rule, exhibit at or near the top of the mast, where they can best be seen, two all-round lights in a vertical line, the upper being red and the lower Green, but these lights shall not be exhibited in conjunction with the combined lantern permitted by paragraph (b) of this Rule.

(d) (i) A sailing vessel of less than 7 m in length shall, if practicable, exhibit the lights prescribed in paragraph (a) or (b) of this Rule, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.
- (ii) A vessel under oars may exhibit the lights prescribed in this rule for sailing vessels, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.

(e) A vessel proceeding under sail when also being propelled by machinery shall exhibit forward where it can best be seen a conical shape, apex downwards.

Rule 26—Fishing Vessels

(a) A vessel engaged in fishing, whether underway or at anchor, shall exhibit only the lights and shapes prescribed by this rule.

(b) A vessel when engaged in trawling, by which is meant the dragging through the water of a dredge net or other apparatus used as a fishing appliance, shall exhibit

- (i) Two all-round lights in a vertical line, the upper being green and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel of less than 20 m in length may instead of this shape exhibit a basket
- (ii) A masthead light abaft of and higher than the all-round green light; a vessel of less than 50 m in length shall not be obliged to exhibit such a light but may do so
- (iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(c) A vessel engaged in fishing, other than trawling, shall exhibit:

- (i) Two all-round lights in a vertical line, the upper being red and the lower white, or a shape consisting of two cones with their apexes together in a vertical line one above the other; a vessel of less than 20 m in length may instead of this shape exhibit a basket
- (ii) When there is outlying gear extending more than 150 m horizontally from the vessel, an all-round white light or a cone apex upwards in the direction of the gear
- (iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(d) A vessel engaged in fishing in close proximity to other vessels engaged in fishing may exhibit the additional signals described in Annex II to these Regulations.

(e) A vessel when not engaged in fishing shall not exhibit the lights or shapes prescribed in this Rule, but only those prescribed for a vessel of her length.

Rule 27—Vessels Not Under Command or Restricted in Their Ability to Maneuver

(a) A vessel not under command shall exhibit:

- (i) Two all-round red lights in a vertical line where they can best be seen
- (ii) Two balls or similar shapes in a vertical line where they can best be seen
- (iii) When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern light.

(b) A vessel restricted in her ability to maneuver, except a vessel engaged in mine clearance operations, shall exhibit:

- (i) Three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white
- (ii) Three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes shall be balls and the middle one a diamond.
- (iii) When making way through the water, a masthead light, sidelights and a stern light in addition to the lights prescribed in subparagraph (i)

(iv) When at anchor, in addition to the lights or shapes prescribed in subparagraphs(i) and (ii), the light, lights, or shape prescribed in Rule 30.

(c) A power-driven vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course shall, in addition to the lights or shapes prescribed in Rule 24(a), exhibit the lights or shapes prescribed in subparagraph (b)(i) and (ii) of this Rule.

(d) A vessel engaged in dredging or underwater operations, when restricted in her ability to maneuver, shall exhibit the lights and shapes prescribed in subparagraphs (b)(i),(ii) and (iii) of this Rule and shall in addition when an obstruction exists, exhibit:

(i) Two all-round red lights or two balls in a vertical line to indicate the side on which the obstruction exists
(ii) Two all-round green lights or two diamonds in a vertical line to indicate the side on which another vessel may pass
(iii) When at anchor, the lights or shapes prescribed in this paragraph instead of the lights or shapes prescribed in Rule 30.

(e) Whenever the size of a vessel engaged in diving operations makes it impracticable to exhibit all lights and shapes prescribed in paragraph (d) of this Rule, the following shall be exhibited:

(i) Three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white
(ii) a rigid replica of the code flag "A" not less than 1 m in height. Measures shall be taken to ensure its all-round visibility.

(f) A vessel engaged in mine clearance operations shall in addition to the lights prescribed for a power-driven vessel in Rule 23 or to the light or shape prescribed for a vessel at anchor in Rule 30 as appropriate, exhibit three all-round green lights or three balls. One of these lights or shapes shall be exhibited near the foremast head and one at each end of the fore yard. These lights or shapes indicate that it is dangerous for another vessel to approach within 1,000 m of the mine clearance vessel.

(g) Vessels of less than 12 m in length, except those engaged in diving operations, shall not be required to exhibit the lights prescribed in this Rule.

(h) The signals prescribed in this Rule are not signals of vessels in distress and requiring assistance. Such signals are contained in Annex IV to these Regulations.

Rule 28—Vessels Constrained by their Draft

A vessel constrained by her draft may, in addition to the lights prescribed for power-driven vessels in Rule 23, exhibit where they can best be seen three all-round red lights in a vertical line, or a cylinder.

Rule 29—Pilot Vessels

(a) A vessel engaged on pilotage duty shall exhibit:

(i) At or near the masthead, two all-round lights in a vertical line, the upper being white and the lower red
(ii) When underway, in addition, sidelights and a stern light

(iii) When at anchor, in addition to the lights prescribed in subparagraph (i), the light, lights, or shape prescribed in Rule 30 for vessels at anchor.

(b) A pilot vessel when not engaged on pilotage duty shall exhibit the lights or shapes prescribed for a similar vessel of her length.

Rule 30—Anchored Vessels and Vessels Aground

(a) A vessel at anchor shall exhibit where it can best be seen:

(i) In the fore part, an all-round white light or one ball
(ii) At or near the stern and at a lower level than the light prescribed in subparagraph (i), an all-round white light.

(b) A vessel of less than 50 m in length may exhibit an all-round white light where it can best be seen instead of the lights prescribed in paragraph (a) of this Rule.

(c) A vessel at anchor may, and a vessel of 100 m and more in length shall, also use the available working or equivalent lights to illuminate her decks.

(d) A vessel aground shall exhibit the lights prescribed in paragraph (a) or (b) of this Rule and in addition, where they can best be seen

(i) Two all-round red lights in a vertical line
(ii) Three balls in a vertical line.

(e) A vessel of less than 7 m in length, when at anchor not in or near a narrow channel, fairway or where other vessels normally navigate, shall not be required to exhibit the shape prescribed in paragraphs (a) and (b) of this Rule.

(f) A vessel of less than 12 m in length, when aground, shall not be required to exhibit the lights or shapes prescribed in subparagraphs (d)(i) and (ii) of this Rule.

Rule 31—Seaplanes

Where it is impracticable for a seaplane to exhibit lights or shapes of the characteristics or in the positions prescribed in the Rules of this Part she shall exhibit lights and shapes as closely similar in characteristics and position as is possible.

PART D – SOUND AND LIGHT SIGNALS

Rule 32—Definitions

(a) The word "whistle" means any sound signaling appliance capable of producing the prescribed blasts and which complies with the specifications in Annex III to these Regulations.

(b) The term "short blast" means a blast of about one second's duration.

(c) The term "prolonged blast" means a blast from four to six seconds' duration.

Rule 33—Equipment for Sound Signals

(a) A vessel of 12 m or more in length shall be provided with a whistle and a bell and a vessel of 100 m or more in length shall, in addition be provided with a gong, the tone and sound of which cannot be confused with that of the bell. The whistle, bell and gong shall comply with the specifications in Annex III to these Regulations. The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the prescribed signals shall always be possible.

(b) A vessel of less than 12 m in length shall not be obliged to carry the sound signaling appliances prescribed in paragraph (a) of this Rule but if she does not, she shall be provided with some other means of making an efficient signal.

Rule 34—Maneuvering and Warning Signals

(a) When vessels are in sight of one another, a power-driven vessel under way, when maneuvering as authorized or required by these Rules, shall indicate that maneuver by the following signals on her whistle:

- One short blast to mean "I am altering my course to starboard"
- Two short blasts to mean "I am altering my course to port"
- Three short blasts to mean "I am operating astern propulsion."

(b) Any vessel may supplement the whistle signals prescribed in paragraph (a) of this Rule by light signals, repeated as appropriate, whilst the maneuver is being carried out:

(i) These signals shall have the following significance:
- One flash to mean "I am altering my course to starboard"
- Two flashes to mean "I am altering my course to port"
- Three flashes to mean "I am operating astern propulsion."

(ii) The duration of each flash shall be about one second, the interval between flashes shall be about 1 second, and the interval between successive signals shall not be less than 10 seconds.

(iii) The light used for this signal shall, if fitted, be an all-round white light, visible at a minimum range of 5 mi, and shall comply with the provisions of Annex I to these Regulations.

(c) When in sight of one another in a narrow channel or fairway:

(i) A vessel intending to overtake another shall in compliance with Rule 9 (e)(i) indicate her intention by the following signals on her whistle.
- Two prolonged blasts followed by one short blast to mean "I intend to overtake you on your starboard side"
- Two prolonged blasts followed by two short blasts to mean "I intend to overtake you on your port side"

(ii) The vessel about to be overtaken when acting in accordance with 9(e)(i) shall indicate her agreement by the following signal on her whistle:
- One prolonged, one short, one prolonged and one short blast, in that order.

(d) When vessels in sight of one another are approaching each other and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall immediately indicate such doubt by giving at least five short and rapid blasts on the whistle. Such signal may be supplemented by at least five short and rapid flashes.

(e) A vessel nearing a bend or an area of a channel or fairway where other vessels may be obscured by an intervening obstruction shall sound one prolonged blast. Such signal shall be answered with a prolonged blast by any approaching vessel that may be within hearing around the bend or behind the intervening obstruction.

(f) If whistles are fitted on a vessel at a distance apart of more than 100 m, one whistle only shall be used for giving maneuvering and warning signals.

Rule 35—Sound Signals in Restricted Visibility

In or near an area of restricted visibility, whether by day or night the signals prescribed in this Rule shall be used as follows:

(a) A power-driven vessel making way through the water shall sound at intervals of not more than 2 minutes one prolonged blast.

(b) A power-driven vessel underway but stopped and making no way through the water shall sound at intervals of no more than 2 minutes two prolonged blasts in succession with an interval of about 2 seconds between them.

(c) A vessel not under command, a vessel restricted in her ability to maneuver, a vessel constrained by her draft, a sailing vessel, a vessel engaged in fishing and a vessel engaged in towing or pushing another vessel shall, instead of the signals prescribed in paragraph (a) or (b) of this Rule, sound at intervals of not more than 2 minutes three blasts in succession, namely one prolonged followed by two short blasts.

(d) A vessel engaged in fishing, when at anchor, and a vessel restricted in her ability to maneuver when carrying out her work at anchor, shall instead of the signals prescribed in paragraph (g) of this Rule sound the signal prescribed in paragraph (c) of this Rule.

(e) A vessel towed or if more than one vessel is being towed the last vessel of the tow, if manned, shall at intervals of not more than 2 minutes sound four blasts in succession, namely one prolonged followed by three short blasts. When practicable, this signal shall be made immediately after the signal made by the towing vessel.

(f) When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power-driven vessel and shall give the signals prescribed in paragraphs (a) or (b) of this Rule.

(g) A vessel at anchor shall at intervals of not more than 1 minute ring the bell rapidly for ten seconds. In a vessel 100 m or more in length the bell shall be sounded in the forepart of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about 5 seconds in the after part of the vessel. A vessel at anchor may in addition sound three blasts in succession, namely one short, one long and one short blast, to give warning of her position and of the possibility of collision to an approaching vessel.

(h) A vessel aground shall give the bell signal and if required the gong signal prescribed in paragraph (g) of this Rule and shall, in addition, give three separate and distinct strokes on the bell immediately before and after the rapid ringing of the bell. A vessel aground may in addition sound an appropriate whistle signal.

(i) A vessel of less than 12 m in length shall not be obliged to give the above mentioned signals but, if she does not, shall make some other efficient sound signal at intervals of not more than 2 minutes.

(j) A pilotage vessel when engaged on pilotage duty may in addition to the signals prescribed in paragraph (a), (b) or (g) of this Rule sound an identity signal consisting of four short blasts.

Rule 36—Signals to Attract Attention

If necessary to attract the attention of another vessel, any vessel may make light or sound signals that cannot be mistaken for any signal authorized elsewhere in these Rules, or may direct the beam of her searchlight in the direction of the danger, in such a way as not to embarrass any vessel Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation. For the purpose of this Rule the use of high intensity intermittent or revolving lights, such as strobe lights, shall be avoided.

Rule 37—Distress Signals

When a vessel is in distress and requires assistance she shall use or exhibit the signals described in Annex IV to these Regulations.

PART E – EXEMPTIONS

Rule 38—Exemptions

Any vessel (or class of vessel) provided that she complies with the requirements of the International Regulations for the Preventing of Collisions at Sea, 1960, the keel of which is laid or is at a corresponding stage of construction before the entry into force of these Regulations may be exempted from compliance therewith as follows:

(a) The installation of lights with ranges prescribed in Rule 22, until 4 years after the date of entry into force of these regulations.

(b) The installation of lights with color specifications as prescribed in Section 7 of Annex I to these Regulations, until 4 years after the entry into force of these Regulations.

(c) The repositioning of lights as a result of conversion from Imperial to metric units and rounding off measurement figures, permanent exemption.

(d) (i) The repositioning of masthead lights on vessels of less than 150 m in length, resulting from the prescriptions of Section 3 (a) of Annex I to these regulations, permanent exemption.

(ii) The repositioning of masthead lights on vessels of 150 m or more in length, resulting from the prescriptions of Section 3 (a) of Annex I to these regulations, until 9 years after the date of entry into force of these Regulations.

(e) The repositioning of masthead lights resulting from the prescriptions of Section 2(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(f) The repositioning of sidelights resulting from the prescriptions of Section 2(g) and 3(b) of Annex I to these Regulations, until 9 years after the date of entry into force of these Regulations.

(g) The requirements for sound signal appliances prescribed in Annex II to these Regulations, until 9 years after the date of entry into force of these Regulations.

(h) The repositioning of all-round lights resulting from the prescription of Section 9(b) of Annex I to these Regulations, permanent exemption.

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Appendix C

Electrofishing Field Manual

C.1 Checklist for Electrofishing Safety and Health Audit

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ELECTROFISHING

FIELD MANUAL

Prepared by

EA Engineering, Science and Technology
1900 Lake Park Drive
Suite 350
Smyrna, Georgia 30080

May 1994

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EA Engineering, Science and Technology		
Environmental Assessment and Management		
Electrofishing Health and Safety Audit Checklist		

Date:	
Site name:	
Crew:	
Boat used:	
Generator used:	
Motor used:	

Safety Equipment	Yes	No
Life preservers on-board for each individual?		
Leak-free electrical insulating gloves and boots available for each individual?		
Note: gloves and boots should extend above the knees and elbows.		
Radio available for emergency contacts?		
Radio properly charged?		
First aid kit in boat?		
Burn Jel bandages available in first aid kit?		
Personnel trainned in first aid/CPR		
Fire extinguisher in boat? (type ABC 5lbs)		
Emergency air horn on-board?		
Funnel available for adding gasoline to generator or pump?		
Note: gasoline should not be added to a hot motor.		
Polarized sun glasses		
Boat Safety		
Lights available and working for nightime fishing?		
Boat equipped with an anchor?		
Boat in good repair free from sharp edges and weak or broken areas?		
Fuel tanks positioned a safe distance from the generator and battery?		
Note: gasoline vapors cannot be allowed to contact hot surfaces or sparks.		
Fuel tanks properly capped and lines leak-free?		
Generator/Pump shut-off switch available to eliminate grounding the spark plug?		
Generator/Pump muffler facing outside the boat and shielded to prevent		
contact in rough seas?		
Foot pedal "dead man" switch controlling the flow of electricity in place in bow of boat?		
Note: device must be operationable for netter(s) to control.		
If no netter foot pedal exists, is there another means of emergency generator shut off?		
Probes used to extend the electrodes to the water made of non-conducting material?		
All electrical connections weather-proof and water tight?		
All electrical conducting surfaces connected to create one circuit on board?		
Note: Separate circuits create "floating metal" which can cause electrocution.		
All surfaces checked with an Ohm meter prior to launching the boat?		
Trailer		
Trailer frame free of significant rust and structurally sound?		
Hitch on trailer solid and working properly with locking hasp?		
Two safety chains present that can be properly connected to the towing vehicle hitch?		
Trailer stand secured properly and can be locked in the vertical and horizontal position?		
Trailer stand and winch handles present and working properly?		
Safety chains present to secure boat to trailer during transportation? (Other than the winch)		
Winch secure and in good working order?		
Winch cable or rope free of broken strands?		

Winch hook a locking type?		
Trailer tires in good shape with adequate tread?		
Trailer wheel bearings been greased (if not sealed)?		
Lights on trailer working properly (brake and turning indicator)?		
Trailer brakes working properly?		
Motor		
Motor bolted to boat with four bolts?		
Motor equipped with proper handles?		
Can the motor be properly locked in the "up" or travel position?		
Emergency motor shut-off connected to operator in case operator falls from boat?		
Post Fishing Checklist		
Generator shut off during rain?		
Boat operated free of sudden turns or changes in direction?		
Comments and items needed for next trip:		
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TABLE OF CONTENTS

1. INTRODUCTION

This field manual was compiled with available documents which describes basic concepts, proper setup, use, safety, and trouble shooting. The information in this document should reduce the field problems resulting from improper use of our electrofishing equipment. Also, by using proper troubleshooting techniques, it will be possible to make many needed repairs in the field thus salvaging field efforts. The information should also increase understanding of how the systems work and how to properly operate them to increase their effectiveness and reduce unnecessary harm to fish.

Several pages summarize information of EA's available electrofishing equipment based on personal experience and available manufacturers guides. After reviewing these documents, personnel with basic mechanical and electrical skills should be able to properly hook-up, operate and trouble shoot the equipment. If, however for any reason an employee feels uncomfortable with the tasks required, they should not proceed. Safety is always EA's main concern. Electrofishing equipment is **DEADLY** if not handled properly. Do not place yourself in any situation you feel Hazardous. Employees should ask for assistance with any tasks they are hesitant about performing on their own.

2. BASIC CONCEPTS

Electrofishing is in many cases the most effective means of collecting fish for scientific purposes. Electrical current is placed in the water to immobilize fish allowing them to be collected with dip-nets. It involves the use of either AC (alternating current) or DC (direct current) to immobilize fish for capture. These two types of current have very different effects on fish. The choice of which current to use depends on the type of study being performed and the importance of returning healthy fish to the water.

AC And DC Current

AC current typically has the most violent effect on fish. Once in the electrical field a fish will immediately "take a posture transverse to the current in such a way as to receive a minimum of voltage" (Coffelt Electronics). This action is called **oscillotaxis.** Fish will be immobilized quickly and the effect will last longer than that of DC current. Great care must be taken in the collection of fish in this manner. If AC current is applied for too long of a period, the fish may not recover. Another drawback to this type of collection is that since fish usually become immobilized almost immediately when hit by the current, some may be missed because they are shocked while several feet below the surface and out of sight.

DC current will in most cases be the preferred method of collection. Fish react in three ways to DC current. First they line up with the direction of the electrical current, then swim toward the anode (positive electrode). This reaction is called **galvanotaxis.** Finally when fish near the anode they are stunned, roll belly up, and collection becomes possible. The effects of DC current do not last as long as of AC current. When the power is turned off the fish recover quickly. Mortality is far more limited than with the use of AC. This along with the fact that fish actually swim to the anode makes DC current the more effective means of electrofishing.

Control Box

AC or DC current can be selected with electrofishing **control boxes.** In addition to controlling the type of current, a control box allows adjustments to how the current acts. Most equipment will allow you select for standard or pulsed output and to vary the pulse width and frequency of pulses which allows for more efficient collections and limits the risk and stress to fish.

Pulsed output means that the electrical current going from the system into the water comes in pulses or waves. When the pulse rate is low and the width of the field is narrow, less current is required to collect fish. This results in less stress to fish. Since conductivity of water (the ease with which an electrical charge to passes through it) varies it is necessary to have the ability to adjust the pulse rate and width for optimum collection with minimum harm to the fish being collected. EA uses a simple rule of thumb to determine what setting is adequate. Adjustments should be made until the unit output reads **5-6 amps.** Less than 5 is probably below the optimum collection output. More than six is probably inflicting too much damage to fish.

The control box also allows selection of voltage output. This selector should be positioned at the lowest possible setting that allows 5-6 amps to be obtained by adjusting the pulse width and rate.

Types of Equipment

There are several types of electrofishing equipment available. EA typically uses boat, backpack, or pram type units. These units differ in the type of power source used and in their application.

Boat electrofishing is utilized where water depths and characteristics make maneuvering the boat possible. EA primarily uses this type of electroshocking in reservoirs and in navigable rivers. Boat electrofishing usually involves the use of a generator as an electrical power source. The generator sends electricity through a control box which allows the operator to adjust the type of electrical current being placed in the water.

Both pram and back-pack electrofishing are designed for use in areas where boat electrofishing may not be possible or practical. Backpack units consist of a power source (a small generator or battery) and a control box mounted on a backpack frame. Two hand held electrodes (anode and cathode) are utilized by the operator to place electrical current in the water. The user is protected from the current by rubber waders and electrical gloves.

Pram shocking involves the use of a power source and electroshocking unit either placed on the bank or in a barge or small boat. Like backpack electrofishing the operator utilizes two hand held electrodes to place current in the water. The methods differ in that the operator is not required to carry the power source. Cables with up to 50 ft of wire allow mobility over a large section of water.

In all types of electrofishing, current is passed through the water between a positive electrode **(anode)** and a negative electrode **(cathode).** EA typically uses a boom mounted anode and the boat hull as a cathode when boat electrofishing. You may however, see different arrangements. In back-pack electrofishing both the anode and cathode are the hand-held probes. In pram shocking, the cathode may be the hull of either the barge or boat carrying the equipment or a cable from a bank-mounted power source. Pram shocking may also be performed with the anode and cathode hand-held as in back-pack electrofishing.

Conductivity

Electrofishing works by passing electrical current through a fishes body causing the effects described above. Several factors effect the amount of current passing through the fishes body and thus the effectiveness of electrofishing. If the conductivity of the fishes body is equal to or slightly above the conductivity of the surrounding water, the electricity will choose the path of least resistance and pass through the fish. The greater the conductivity of the fishes body in relation to the surrounding water, the greater the effect of the electricity on the fish. The conductivity of fish flesh differs among species. When shocking you may observe catfish floating up as far as 50 ft from the boat. At the same time scaled fish may not succumb to the current until they actually pass within a few feet of the anode. Also larger fish tend to receive a larger charge electricity than do smaller fish.

Another factor that influences the effectiveness of electroshocking is the conductivity of the water. Pure distilled water will actually act as an insulator in an electrical current. This is because there are few electrolytes or dissolved solids to conduct the electricity. It would take a great deal of current to pass through this type of water. Conversely the water of a typical lake or river in the South may be very high in dissolved solids. This water will readily conduct very low amounts of current. In all cases the conductivity of the water must be equal to or below the conductivity of the fishes body for electrofishing to be effective. It is not effective to shock in salt water because it is an electrolyte solution. The conductivity of the water is so much higher than that of the fish in it that an electrical current will find that the path of least resistance is actually around the fish rather than through it.

Conductivity of the water being surveyed should always be checked before attempting electrofishing. If it is very low or extremely high, a different type of collection should be considered. When backpack or pram shocking small streams it may actually be possible to increase the conductivity of the water by placing a block of salt upstream of the study area several hours before beginning your survey. This however should only be considered in very controlled conditions.

Equipment Operation

A typical boat shocking survey would be made up of two or three team members. The team leader or an experienced technician will operate the boat and shocking system while the other crew member(s) will stand at a bow mounted railing and collect fish with properly insulated dip nets. Either the operator or the netter will operate a foot switch which will immediately cut the power output if released. This is a very important safety feature and no electroshocking boat should be operated without safety switch.

Backpack and pram shocking are slightly more hazardous than boat shocking because of the users position in the water with the electrical charge. Field training sessions should be completed with an experienced backpack or pram operator before attempting this technique. Basically the system is a miniaturized version of the boat system. At least two operators are required. One person monitors equipment while the other handles the electrodes. One of the electrodes has a dip-net attached to the end. The operator wades through the water holding the electrodes 2-3 feet apart. Thumb switches on the handles of the probes serve the same function as the foot switch on the boat. When a fish is shocked the operator dips it up with the net, releases (turns off) the switches on the handle and places it in a bucket carried by the second crew member. When pram shocking special attention should be paid by all crew members to the size of the electrical field. If the cathode is mounted on a barge, boat, or bank the electrical field will reach from that point to the anode held by the operator. When backpack shocking this field is concentrated only around the two probes.

3. SAFETY RULES

Safety is a matter that should be foremost on all crew members minds when conducting electrofishing operations. The amount of current in the water may at times be in excess of 600 volts. The amount of amperage generated during typical shocking operations averages 6 amps. This is enough to **Kill** you if you come in direct skin contact with an electrical source such as a cathode, anode, or improperly grounded boat or generator. This hazard is compounded by the fact that the boat and other equipment may be wet.

Always follow the manufacturers instructions when installing or operating electrical equipment. Applicable manuals have been included in this binder. It is each crew members responsibility to familiarize themselves with this information. Furthermore it is the responsibility of each crew member to assure that others are following proper procedure. If you are asked to do something that you feel is improper or unsafe, you have the authority to refuse. Don't depend on someone else to look out for you. Look out for yourself. Read through these manuals so that you have a understanding of what is safe and what is not.

Despite all of this, electroshocking surveys can be conducted in a safe manner. All that is required is proper attention to detail and the use of the safety equipment provided to you.

Here are some common sense rules that **Must** be followed by all crew members at all times:

1. Read the available literature; know what you are doing.
2. Take first aid and CPR. Know how to use it and when.
3. Stay alert! Watch out for the other guy.
4. Always wear PFD.
5. Correctly hook up equipment, check for hazards.
6. If wading is involved, be sure waders are in good shape. **No Leaks!**
7. Wear electrical gloves when operating electroshocking equipment.
8. Never touch a loose wire or make an adjustment while unit is in operation.
9. Always use safety switchs.
10. Never over extend yourself when netting fish.
11. Warn observers of danger.
12. Know proper boating safety
13. Communicate hazards to boat operator. The operator has a limited view in front of the boat because of the position of the netters. Don't assume he/she sees what you see. If noise level restricts normal conversation, establish hand signals.
14. Never place your hand in the water.
15. If gloves become wet inside, turn off equipment and dry them.
16. Keep boat deck as dry and clear of obstacles as possible.
17. Look up from the water from time to time to assure that overhanging branches or other items don't pose a risk.

18. Take breaks, fatigue leads to accidents.
19. No Horseplay.
20. If you have a question, Ask...

See the following pages for safety information extracted primarily from Coffelt's manuals.

Some shocking facts about...

Coffelt Electronics

LEADERS IN ELECTROFISHING EQUIPMENT

FACTS AND SAFETY TIPS ON ELECTROFISHING

EMERGENCY MEASURES

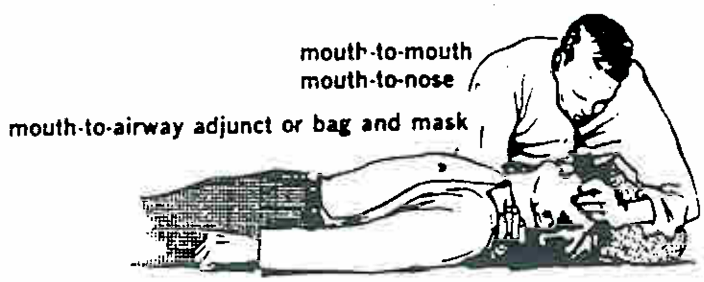
Heart-Lung Resuscitation

IF UNCONSCIOUS

Airway - Open by tilting head back

IF NOT BREATHING

Breathe - Inflate lungs rapidly 3-5 times

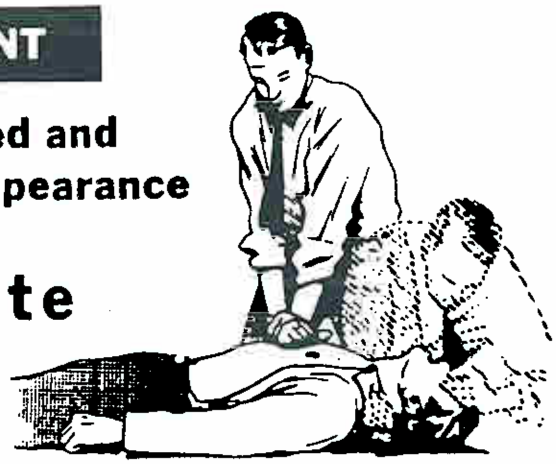


IF CAROTID PULSE IS PRESENT
continue 12 lung inflations per minute

IF PULSE IS ABSENT

Pupils dilated and deathlike appearance

Circulate



Depress Sternum 1½" to 2" once per second

CONTINUE RESUSCITATION until spontaneous pulse returns

ONE OPERATOR – alternate 2 quick inflations with 15 compressions

TWO OPERATORS – interpose one inflation after every fifth compression

YOUR HEART ASSOCIATION

produced by the American Heart Association • 44 East 23rd Street, New York, N. Y. 10010

Mouth-to-Mouth (Mouth-to-Nose) Method of ARTIFICIAL RESPIRATION

If there is foreign matter visible in the mouth, wipe it out quickly with your fingers or a cloth wrapped around your fingers.

a. Tilt the head back so the chin is pointing upward (Fig. 1). Pull or push the jaw into a jutting-out position (Fig. 2 and 3).
These maneuvers should relive obstruction of the airway by moving the base of the tongue away from the back of the throat.


Fig. 1


Fig. 2

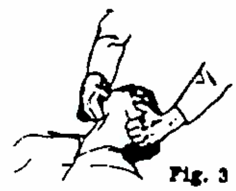


Fig. 3

b. Open your mouth wide and place it tightly over the victim's mouth. At the same time pinch the victim's nostrils shut (Fig. 4) or close the nostrils with your cheek (Fig. 5). Or close the victim's and place your mouth over the nose (Fig. 6). Blow into the victim's mouth or nose. (Air may be blown through the victim's teeth, even though they may be clenched.)
The first blowing efforts should determine whether or not obstruction exists.

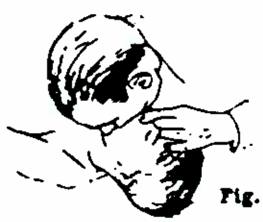


Fig. 4


Fig. 5

c. Remove your mouth, turn your head to the side, and listen for the return rush of air that indicates air exchange. Repeat the blowing effort.
For an adult, blow vigorously at the rate of about 12 breaths per minute. For a child, take relatively shallow breaths appropriate for the child's size, at the rate of about 20 per minute.

d. If you are not getting air exchange, recheck the head and jaw position (Fig. 1 or Fig. 2 and Fig. 3). If you still do not get air exchange, quickly turn the victim on his side and administer several sharp blows between the shoulder blades in the hope of dislodging foreign matter (Fig. 7).
Again sweep your fingers through the victim's mouth to remove foreign matter.


Fig. 6

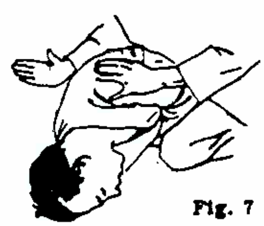


Fig. 7

Those who do not wish to come in contact with the person may hold a cloth over the victim's mouth or nose and breathe through it. The cloth does not greatly affect the exchange of air.

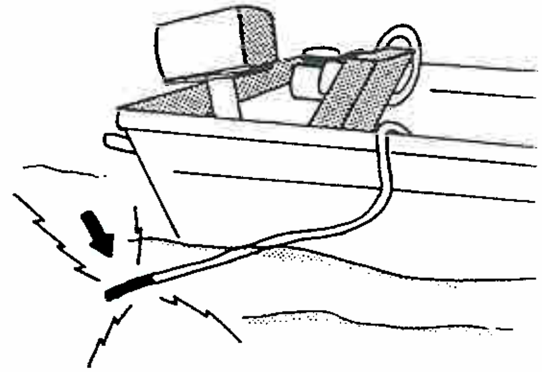
Don't be shocked - Son

1. WEAR THE PROPER SAFETY ITEMS:

Three basic safety items must be worn by those involved in electrofishing. 1. LIFE JACKET - Even if you are an excellent swimmer or working in shallow water your life may at some time depend on a life jacket. Don't be without it! 2. WADERS - High waders are preferrable. Make sure there are no leaks. [If you have leaks, you'll probably find them when the juice is turned on]. 3. RUBBER GLOVES - The easily slipped on gauntlet type are best. Always watch what you touch when working with electricity.

2. NEVER TOUCH THE ANODE OR CATHODE:

Since the business end of an electrofishing unit is its probes, it should be clear they are not to be touched under any circumstances. Make sure you are aware of their location at all times. Also make sure you do not operate any conductive equipment near the probes.



3. KEEP BOOTS AND GLOVES DRY:

If you have leaks in your boots or gloves you run the same risk as the fish. Maintain all protective clothing in a waterproof, shockproof condition. Make sure you are thoroughly dry during an electrofishing operation.

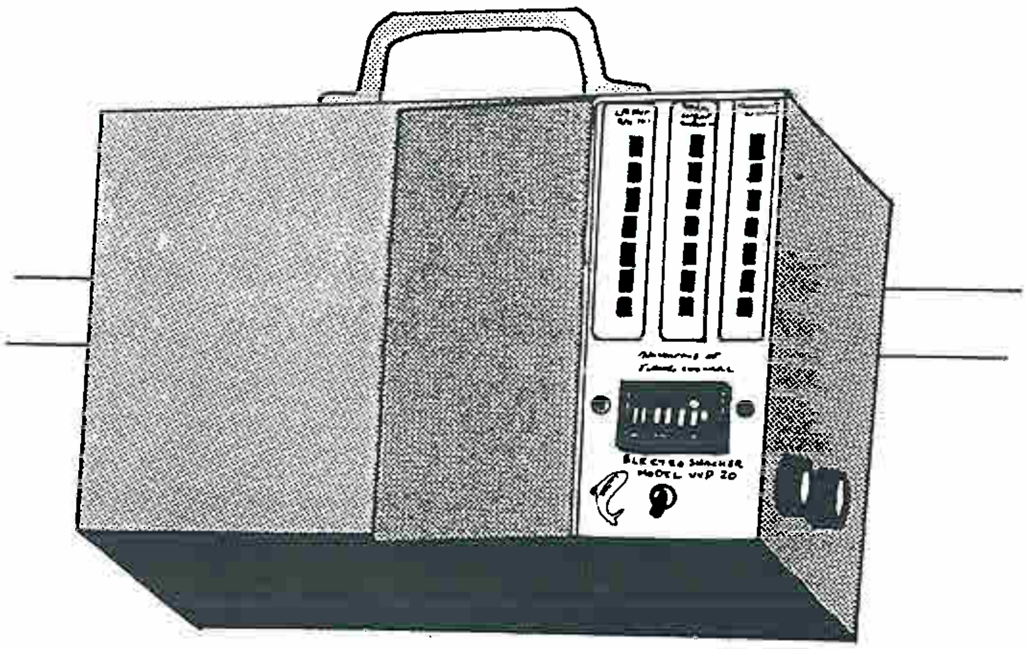
4. KEEP OTHER PEOPLE CLEAR OF AREA:

Before starting an electrofishing operation make sure that everybody, including pets, is in a safe place. Everyone on shore should be kept at a safe distance and only authorized people should participate in the operation. Remember you are using a very powerful force which can be lethal to unprotected persons or animals.

important safety tips:

5. USE PROPER EQUIPMENT:

As suggested before - make sure you use the appropriate equipment. Commercially designed units have every possible safety feature built into them in the testing stages. Don't take chances with poorly designed, home-made equipment. It just isn't worth the risk!



6. FOLLOW MFRS. OPERATION INSTRUCTIONS:

Reliable professionally designed equipment comes with complete operating, safety and hookup instructions. Even if you think equipment operation is perfectly obvious, read and understand every step; then read it again. It is very important to you.

7. KNOW PROPER FIRST AID PROCEDURES:

If trouble should occur, your life or someone elses may depend on adequate knowledge of first aid. Keep on hand a well equipped kit and check it often. Be especially familiar with the proper techniques for mouth-to-mouth resuscitation.

When all safety and proper operating procedures are followed, electrofishing is a safe operation. Don't allow yourself to be narcotized with the fish by foolishly ignoring basic safety rules and procedures.

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STATIC ELECTRICITY

Here's how to understand and prevent gasoline explosions that occur due to improper grounding of the fuel system

By Geoffrey Smith

THE BLAST came out of nowhere as far as anyone could see. I came to in ice-cold water fighting to get rid of my rubber hip boots and mackinaw, then swimming up wind to get away from the flames. The score was this: One sailor killed, the total loss of a coastwise schooner and half the pier burnt away. The cause: static electricity.

All this happened 34 years ago on the West Coast of Canada. We knew very little about handling gasoline except that it was considered somewhat dangerous to smoke. There were no dockside pumps at this out-of-the-way harbor and accepted re-fueling practice was to roll drums of gasoline down the pier, hoist them aboard and suspend them from a boom over an out-size funnel fitted into the fill pipe. One man handled the operation on deck, unscrewed the bung, steadied the drum over the funnel and controlled the flow of gasoline by opening and closing the vent. This was the man who was killed—he had spelled me so that I could warm up in the lee of the deck house and catch a smoke.

Our ship and dozens of others had used this method of refueling hundreds of times and nothing had ever gone wrong. It may have been because of the crisp dry weather, it may have been that the drum was hoisted a little higher than usual and the gasoline flowed farther and faster into the funnel. Neither of these explanations was of any great comfort to the captain of the schooner, the owner of the pier or the dead sailor's widow.

In the next couple of years I was involved directly or indirectly with three more gasoline explosions, all of them due to human error. One was when cargo was stowed in an air shaft, reducing ventilation, and a sea-going schooner went up a hundred miles off-shore from the fumes of a leaky beat-up engine. The second time was when we went to the help of an out-of-fuel fishing boat, and gasoline fumes from a now-illegal under-deck vent seeped 30 feet to an open galley fire. The third time was when a deck hand filling a five-gallon can for a light plant moved an oil lantern closer so he could see better. Since then I have learned a lot about gasoline.

Static electricity is generally considered to be frictional electricity generated by two dissimilar materials passing over each other, such as gasoline flowing through a pipe into the air, a car rolling along a highway, or you yourself brushing your hair or walking across a carpet. These and many other actions cause electrical rearrangement. How many times have you reached for a door knob and received an electrical shock, or fondly petted the family dog or cat and had the little animal take off with every hair standing on end? Nylon and other synthetic cloth is particularly conducive to the creation of static electricity and in the dark you can see it. These examples of static occur generally in very dry weather, but when filling your boat's tank it can happen at any time.

Along the coast we generally feel static sparks in the cold weather which a Northwest wind brings in and naturally assume that it is most prevalent in the winter. One reason behind this is that warm weather in coastal waters usually goes with high humidity and the dampness of the air tends to dissipate the electrical discharge.

Your main protection against static electricity while refueling is grounding, also known as bonding, which is direct metal-to-metal contact from the fuel hose nozzle to the water in which your boat is floating.

The first step is to be sure that the hose nozzle is in direct contact with the fill pipe deck fitting. Most fill pipes are metal and consequently you have metal contact to the fuel tank, but in some cases the pipe may be rubber or plastic which, although dangerous, is sometimes used for economy where there are complex curves. If you have such a fill pipe your best bet is to replace it with metal or make a connection with copper wire (8 to 10 gauge or bigger) from the deck fitting to the tank. Should you use solder be very sure that the tank is empty and free from fumes.

Your next concern is the fuel line from tank to engine. If it is metal you have nothing to worry about, but if it is plastic or other non-metallic material you must follow the procedure given above for the fill pipe. Once you are grounded to the engine there is direct metal contact through the engine casing and propeller shaft to the water. In the very rare case where there is a non-metallic gasket on the shaft to allow for play you must set up a metal contact either through it or over it.

Recently fiberglass gasoline tanks have come into being. These pose problems of their own. One method of grounding would be to run a copper wire around the tank from fill pipe to fuel line, but this would not ground the fuel in the tank. An expert on the subject suggests the manufacturers imbed the wire in the fiberglass connected to intake and outlet fittings. This would avoid corrosion which could occur if a wire went through the fuel.

It is not necessary to have a big static spark to set off an explosion—anything you can feel is enough. Even the spark caused by brushing your hair will do it under the right combination of fumes and air.

A disquieting thought is that, under certain atmospheric conditions, you can cause a static explosion yourself, particularly if you are wearing synthetic clothing and the almost certainty if you are insulated by rubber soled shoes. So, for safety's sake and the remote chance, ground yourself before you open the fill pipe deck fitting and release fumes to the air. You can do this by dipping your hand into the water overside, touching the engine block or a metal fitting on the dock connecting to the water.

Diesel fuel is too lean for static electrical explosion under normal conditions, but should it vaporize through contact with hot metal or if a leak in hose or nozzle forms a fine mist, it is potentially dangerous.

Another danger point is water. If there is water present with the fuel you are taking aboard the possibility of static spark increases ten to 20 fold.

Gasoline is dangerous unless it is handled properly. Pound for pound, in the right air to vapor mixture, it has more explosive power than T.N.T. But it is a fine efficient fuel and all you need do is treat it as you would the sea itself: with infinite respect. — ⊥

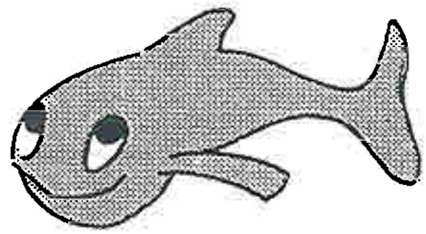
Let's start with the basic elements:

WATER

COMES HARD OR SOFT,
CAN RUN FAST (STREAMS)
OR BE DEEP (LAKES).

The first thing you need is some water. It comes in all types from fast running mountain streams to deep rivers and lakes. It seems almost every location has some different water problem for the electrofisher. The hardness [number of dissolved particles] determines the conductivity of the water, or how well it will carry an electrical current. The conductivity of water is measured by ohms per centimeter. The higher the ohms number the softer the water. Water temperature is another variable affecting the electrofisher.

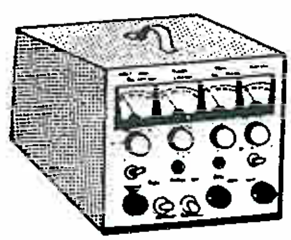
FISH



COMES LARGE AND SMALL
AND IN DIFFERENT KINDS.

Fish come large-small-fat-skinny-handsome-ugly, etc. Various species of fish react differently to electro-shocks. For instance large fish are influenced more quickly and by relatively smaller voltages. Fish also have different densities of flesh which means that conductivity can vary from species to species.

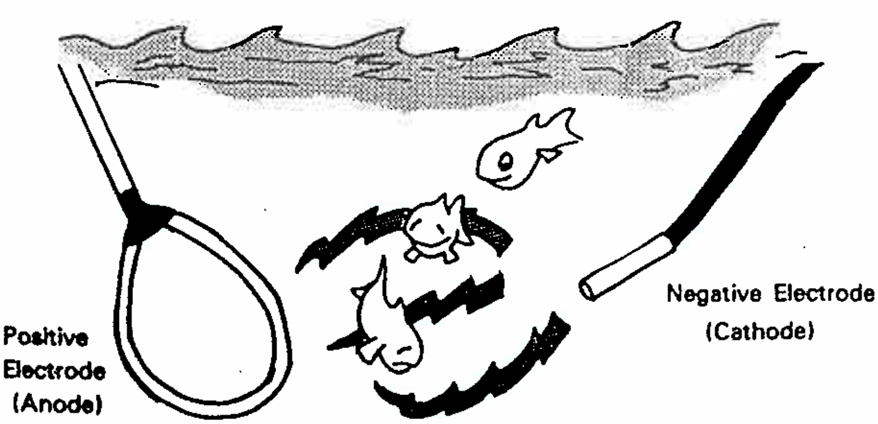
ELECTROSHOCKER



COMES IN A VARIETY OF
SHAPES AND SIZES TO
DO DIFFERENT JOBS.

Our first suggestion is to use an electronic unit which is designed and tested for electrofishing. Home-made units can be very dangerous. Electroshockers basically are designed to put electricity into water. The more control you have over the types of electric current, the more successful you're going to be in dealing with the variables involved. The two basic types of electricity used are AC or DC. [More about that later.] Choose the unit that best suits the physical surroundings, type of water and fish you are going after.

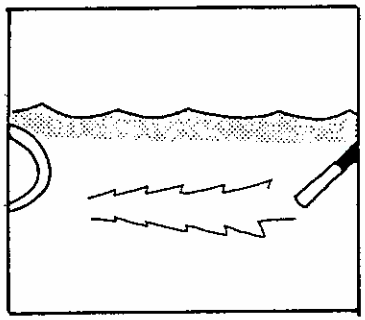
Put them all together and they spell ZAP!



Electricity needs positive and negative electrodes to complete a circuit. In boat electrofishing the negative electrode [cathode] usually hangs over the boat's side. The positive electrode [anode] can dangle from a boom or be hand maneuvered. You put them into the water, aim at the fish, turn on the juice [after following all safety and proper operating procedures] and the result is a bunch of surprised fish.

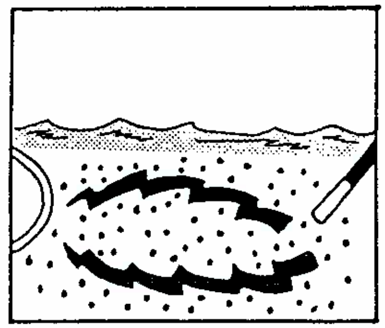
It's the variables that make electrofishing interesting:

Water Conductivity:



LOW CONDUCTIVITY - HARD TO GET ELECTRICITY FROM POS. TO NEG.

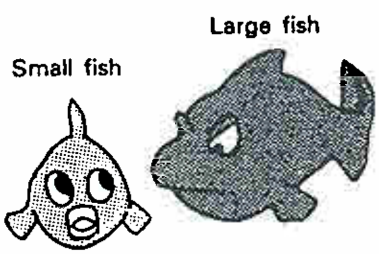
The amount of dissolved solids in the water determines its conductivity. The fewer the dissolved solids the harder it is to pass electrical current from positive to negative electrodes. For instance, distilled water is actually an insulator. Hard water, with lots of dissolved solids is a good conductor and current passes readily between anode and cathode.



HIGH CONDUCTIVITY - EASY TO PASS CURRENT FROM POS. TO NEG.

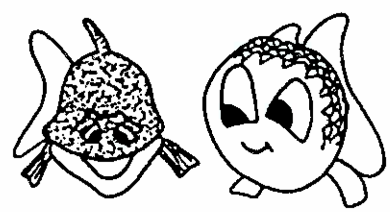
You might think that high water conductivity automatically means really good electrofishing. Not necessarily so. This is where the size of fish and the density of their flesh is important. As an example salt water has very high conductivity, but fish have relatively less conductivity in their bodies and the electrical current sort of slides around them requiring more voltage for a reaction.

When the conductivity of the water is lower than the conductivity of the fish, electrofishing conditions are more favorable. Electrical force lines are drawn to the fish with a resultant satisfactory reaction. Again control of current, pulse, etc. is essential for best results.



LARGE FISH REACT TO CURRENT MORE THAN SMALL FISH.

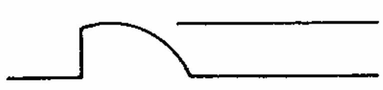
Larger fish receive a greater voltage in the water than smaller fish and are influenced more quickly and by relatively smaller voltages. Furthermore, the conductivity of fish flesh varies from species to species and environment to environment.



FISH FLESH OF DIFFERENT SPECIES CAN HAVE DIFFERENT CONDUCTIVITIES.

Variable shocking waves & currents help match the right shocking to the water conditions

AC-60 hz. Sine wave form.

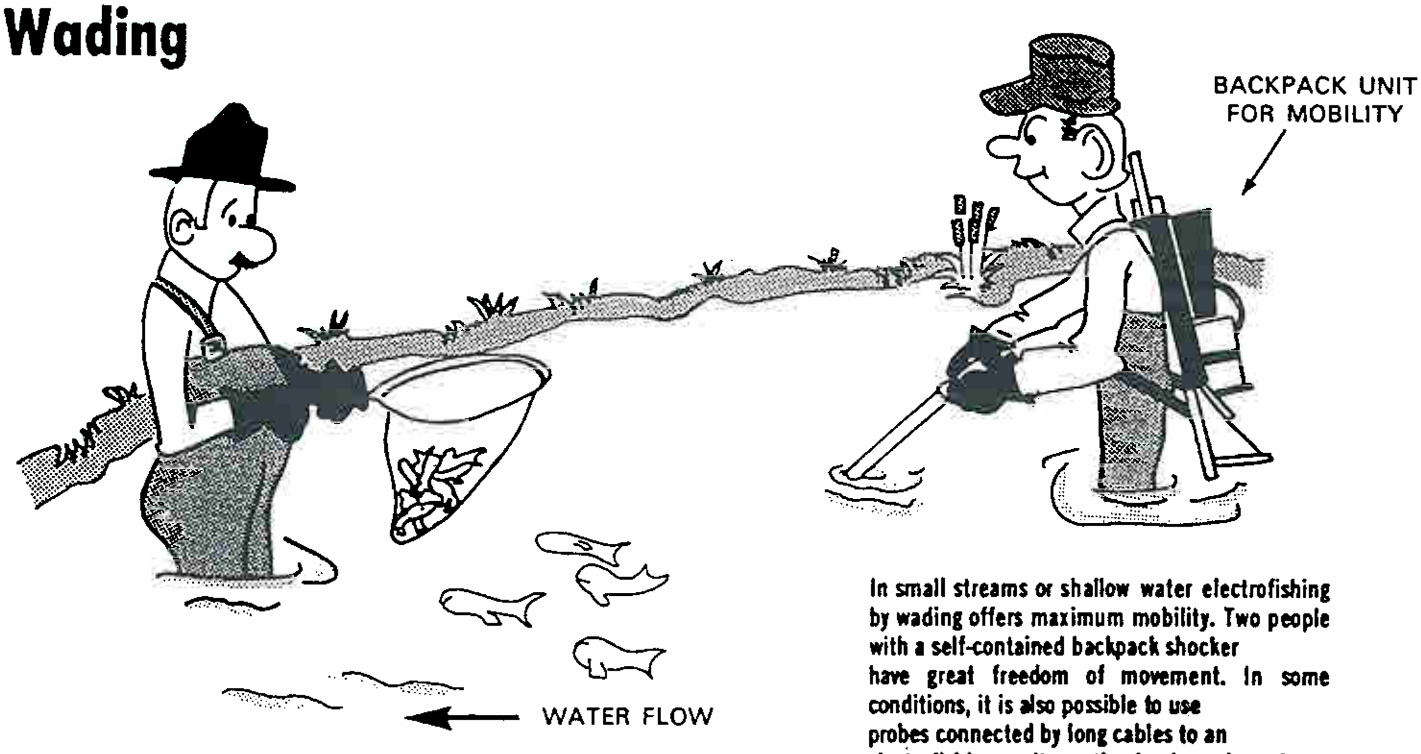


Square wave form. DC Pulse.

As we've suggested, the more control over the type of current and pulse rate, etc. the better the chances for successful electrofishing. It's not our intention to get too technical, but to give you some idea of the basic principles of electrofishing. In summation, you can introduce continuous Alternating or Direct currents into the water, or you can break the current by pulsing a certain number of times per second. This is extreme simplification and for more detailed consideration there is an abundance of technical data available.

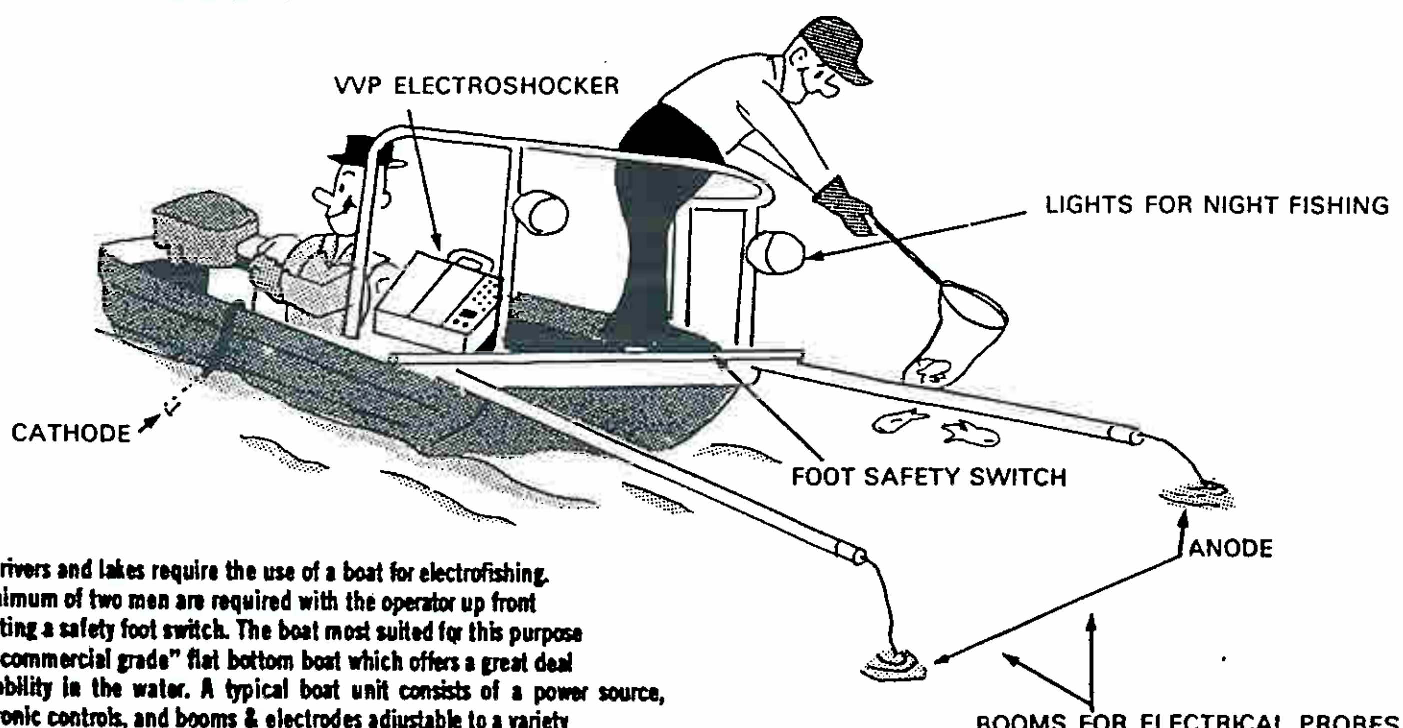
A couple of popular electrofishing set ups:

Wading



In small streams or shallow water electrofishing by wading offers maximum mobility. Two people with a self-contained backpack shocker have great freedom of movement. In some conditions, it is also possible to use probes connected by long cables to an electrofishing unit on the bank or in a boat.

From a boat:



Most rivers and lakes require the use of a boat for electrofishing. A minimum of two men are required with the operator up front operating a safety foot switch. The boat most suited for this purpose is a "commercial grade" flat bottom boat which offers a great deal of stability in the water. A typical boat unit consists of a power source, electronic controls, and booms & electrodes adjustable to a variety of conditions.

A suitable holding tank should be available to contain fish. Several sizes of boat are available with the component equipment outfitted to individual needs.

WARNING

HIGH VOLTAGE

IS USED IN THE OPERATION
OF THIS EQUIPMENT

DEATH ON CONTACT

MAY RESULT IF OPERATING PERSONNEL
FAIL TO OBSERVE SAFETY PRECAUTIONS

BE CAREFUL TO AVOID CONTACT WITH HIGH-VOLTAGE CIRCUITS
OR 115VAC INPUT CONNECTIONS WHILE CHECKING OR
SERVICING THIS EQUIPMENT

DIRECT CURRENT is a flow of current in one direction only. This flow is from the negative cathode to the positive anode.

The reaction of fish to direct current is quite different from their reaction to alternating current. The first reaction of the fish is to turn their heads toward the positive anode and start to swim toward it. This reaction, known as galvanotaxis, will continue until the fish either reaches the anode or encounters a current sufficiently strong enough to cause it to turn on its side and become incapable of any further forward movement. This reaction is known as galvanonarcosis. The severe and often harmful muscle contractions encountered with alternating current do not occur and the fish recover much more quickly from a direct current shock. Thus the mortality rate is much less with direct current than with alternating current. Also, galvanotaxis does not occur with alternating current.

Even greater anode attraction is possible by the use of pulsed direct current. Pulsed direct current is obtained by interrupting a direct current flow with an electronically controlled switch which will give a number of on and off pulses of direct current. Different species of fish differ in the number of pulses per second which will best attract them. Adjustment of pulse frequency and duration are of great importance in electrofishing to produce the desired galvanotaxis reaction.

Experimentation has shown that a fast rising pulse of 325 volts to 425 volts and with a frequency of 40 to 80 pulses per second is the most desireable for optimum results in streams in the range of 35 μmhos to 1000 μmhos per cm^3 conductivity.

The Type VI, Type VII, and the Type VIII electrofishers were designed for use in waters whose conductivity ranges from 20-1350 micromhos, 20-1000 micromhos, and 35-500 micromhos, respectively.* The Type VI is for use in large lakes and rivers and the Type VII is for medium size streams and lakes, and the Type VIII is for use in small fresh water streams. All Smith-Root electrofishers were designed to incorporate the desireable characteristics listed above.

* These figures correspond to the following resistivity ranges: Type VI- 750 - 50,000 ohms/cm^3; Type VII- 1000-50,000 ohms/cm^3; Type VIII- 2000-30,000 ohms/cm^3.

To convert ohms/cm^3 to conductance: $\text{Micromhos} = \frac{1 \times 10^6}{\text{ohm/cm}^3}$

CONSIDERATIONS FOR ELECTROFISHING

The effectiveness of the shocker's output is sometimes effected drastically by environmental and/or biological factors.

Generally speaking, the shocker's output is not greatly modified by the waters resistance or temperature, however, the power that reaches the fish is greatly effected by the water's parameters and the animals physiological make-up.

If these environmental and biological parameters are too far out of line, poor electrofishing will result. Adjustments in the shocker's output can help to reduce erratic actions and the escape of fish.

The following discussion may help to clarify the wide variation of reactions among fish.

INFLUENCE OF RESISTIVITY

The resistivity of the water and of the fish flesh are the main factors that effect electrofishing.

The resistivity of natural water depends on the quantity of dissolved salts and minerals in the water available to carry electric current.

Distilled water is a very good insulator of electric current. If a voltage is applied between two electrodes in distilled water, little or no current would flow through the water and the water would be considered to have extemely high or infinite resistivity.

In the past it was customary to talk in terms of volts per inch required to envoke a given response in a fish. From a theoretical standpoint, it is possible to have many volts per inch and not shock the fish at all.

For example, if a fish were placed in distilled water with high voltage applied, no current would pass through the water and hence, no current would pass through the fish's body even though many volts per inch may be present. What a fish reacts to is the current flowing through its body.

On the other side of the coin if we were able to put a fish in water that had near zero resistance and applied a voltage, a corresponding large current would flow through the water but negligible current would flow through the fish's body because the electric current would find it much easier to pass through the low resistance water than through the fish's flesh of medium to high resistance.

It can be seen from the afore mentioned considerations that a fish will receive the maximum shock (current flow) when a voltage is impressed across water having a resistance per cube equal to the resistance per cube of fish flesh. Typically fish flesh ranges from about 1.5 Kohm per cube to as high as 5 Kohm per cube. Successful electrofishing can be carried out in water with a mismatch ratio or resistance of about 3:1.

Practices which reduce the effects of high resistance water by delivering more useful electrical energy to fish include the use of high frequencies and duration with the use of square waves with peak voltages of 300 to 400 volts; it also helps to maintain a large cathode while keeping the anode medium size (not over 100 sq. in.). The smaller anode has a more intense current field near the anode while a large anode distributes the current over a larger area.

In some areas water resistivity is so high that electrofishing is impractical. The upper limit of resistivity for electrofishing is about 30,000 ohm per cube. In some cases this problem has been helped by adding salt to the water to lower the resistivity to a level more suitable for electrofishing.

In waters of very low resistivity the only solution is to run very heavy current through the water. However, a limit is soon reached where the shocker cannot deliver sufficient current to electrofish successfully. The lower limit on resistivity suitable for electrofishing is about 300 ohms per cube.

Individual variation is notable among fish even though they are of the same species and have similar lengths. However, the longer the individual of a species, generally, the more sensitive it is to electrical shock as fish absorb power as a function of body surface area.

EFFECTS OF TEMPERATURE

Fish flesh has a certain resistivity that decreases with increasing temperature. The success of electrofishing may be enhanced or hindered by this effect depending upon whether the water's resistance is higher or lower than the fish flesh resistance. If it is in a direction to cause a closer resistivity match, the fish will receive a greater shock.

Output energies commonly used in electrofishing are capable of killing fish. Death can occur with or without gross physical damage or by irreversible physiological damage. Mortalities caused by A. C. electrofishing are usually higher than those caused by D. C. or pulsed D. C.. Harmful effects from pulsed D. C. are usually a result of excessive exposure or very intense electrical fields.

ELECTROFISHING TECHNIQUES

One engaged in electrofishing must wade or float, depending upon the depth or swiftness of the water. In suitable waters, the operators wade and can probe the anode into likely fish habitat. Wading upstream eliminates the effects of turbidity caused by bottom sediment. Furthermore, if collections are for food-habit study, stunned prey are not swept downstream and consumed by predators. If turbidity and predication are unimportant, however, collections can be made more efficiently and less strenuously when moving downstream. The fish are normally oriented upstream, or toward the descending electrical field, and the shocked fish initially induced into flight bolt upstream into higher voltage densities, where they are held. Fish that manage to escape are often captured a short distance downstream. The size of the fish captured by wading operations in large streams is usually less than 150 mm., whereas larger fish are taken in deep waters by the floating method.

The floating method of electrofishing is used when the stream is too deep or swift to wade. The anode is clamped rigidly ahead of the boat, extending into the water. One man guides the boat with the oars while one or two operators dip fish as the boat drifts with the river.

Collecting can be improved further by introducing the element of surprise through intermittent fishing. The intensity of the anode's peripheral electric energies only frightens fish, causing them to bolt or penetrate deeper into cover. In either situation, chances of capture are reduced. It is better not to move through a body of water with the power continuously on, but rather to fish only in likely habitat. Fish can be extracted from areas of heavy cover or from under shore ice by inserting the anode, turning the power on, and withdrawing the anode slowly and smoothly. Fish follow the anode under the influence of galvanotaxis into the open, where they can be netted. If the stream velocity is appreciable, the electrical power can be left on during floating without loss of efficiency.

Night fishing with lights has proven to be exceedingly productive in lakes but it is not so in streams. The reflection and refraction of the spotlight beam caused by the ruffled stream surface greatly impairs sighting of the fish. Headlamps are useful for electrofishing by wading at night. For daytime fishing the use of Polaroid sunglasses greatly improves in locating stunned fish.

SAFETY PRECAUTIONS FOR ELECTROFISHING

The operator of an Electrofisher must always keep in mind that his chance of receiving an electrical shock is multiplied when dealing with electric currents in or near water more than any other place. Using an Electrofisher is like using a firearm, if used properly and with good judgement it is perfectly safe. Have respect for electricity and it is easily controlled, lose respect and you could lose your life.

The Smith-Root Electrofishers have a HIGH VOLTAGE OUTPUT and certain safety precautions must be observed to provide safe operation and prevent possible dangerous electric shock.

When operating the Electrofisher NEVER let yourself come in contact with the anode. If this were to happen your body would complete a path for the electric current and a possible lethal shock would result.

The following articles must be worn when using the Electrofisher. They are not just to keep you dry, they are to keep you insulated from the electric currents that may be present.

1. Nonleaking wading boots chest high. If they become wet inside, STOP electrofishing and let them dry out thoroughly. Wet boots can conduct electricity as well as water around them.

2. Nonleaking rubber electricians gloves that reach the elbow or higher. If they become wet inside, STOP electrofishing and let them dry out. Wet gloves conduct electricity.

THE FOLLOWING ARE SOME DO'S AND DON'TS FOR ELECTROFISHING

DO – Always make sure that all personel are clear of the area surrounding the anode before turning on the power. DOUBLE CHECK.

DON'T – Continue to electrofish if your boots or gloves become damp or wet.

DO – Make sure that the anode and cathode electrodes make good connection with the output cable and that both electrodes are in contact with the water.

DON'T – Operate an electrofisher if you have any prior heart ailment history or if you have been under abnormal strain, which may weaken your heart.

DO – Study and know how to administer first aid treatment for electrical shock.

DO – BE CAREFUL!

FRONT PANEL CONTROLS AND PLUGS:

BEFORE ATTEMPTING OPERATION OF THIS EQUIPMENT BE SURE TO READ AND FOLLOW THE INSTRUCTIONS AND SAFETY PRECAUTIONS'

INPUT PLUG – Located lower left. This supplies all power for the Type VI Electrofisher. Do not plug a Type VI that is set up for 220 VAC input into a 110 VAC outlet or a Type VI set up for a 110 VAC into a 220 VAC outlet or serious damage to the unit may result.

POWER SWITCHES – Located lower left. These are circuit breaker switches used to turn on and off the input power and the auxiliary power outlets.

POWER INDICATOR – Located lower left. Will be lighted when input plug has power applied and power switches are in the on position.

OUTPUT MODE SELECTOR SWITCH – Located lower right. Selects actual output waveshape and frequency, 60 HZ A.C. Sine wave, 60 PPS or 120 PPS pulsating D.C.

VOLTAGE SELECTOR SWITCH – Located top left. This switch selects output voltage providing steps of 100 volts per step over the range of 0 to 600 VAC and 0 to 850 volts peak D.C.

HIGH VOLTAGE INDICATOR – Located center right. Indicates when power is being supplied to the anode-cathode electrodes.

PULSE WIDTH CONTROL – Located lower right. Adjusts pulsating D.C. output pulse width within the range of 1 to 7 milliseconds.

AMMETER – Located top center. Indicates the current flowing through the water via the anode-cathode electrodes.

MECHANICAL REGISTER – Located upper left on front panel. Records actual shocking time in seconds. Actuated at one count per second only when high voltage is applied to the anode, and the timer switch, (located just to the right of the mechanical register) is in the on position.

KEY SWITCH – Located lower left. The provided key must be inserted and this switch turned on before the remote switches can be actuated to supply high voltage to the anode. This way high voltage can only be obtained deliberately for obvious safety reasons.

REMOTE INPUT PLUG – Located lower right. Remote switches provided with your Type VI Electrofisher are plugged in here and are used to actuate the circuits supplying high voltage to the anode. With the key switch (lower left panel) in the on position, BOTH remote buttons must be depressed to obtain high voltage at the anode. This is an added safety precaution so there will never be high voltage unless two operators press their respective buttons simultaneously.

OUTPUT PLUG – Located lower right. Both the anode and cathode wires are connected to this plug. Pin "A" goes to the anode and Pin "B" to the cathode. The output cable supplied is wired so that the white wire must be connected to the anode and the black to the cathode.

FUSE, 6 AMP – Located upper right. Limits output to 6 amperes and protects high voltage circuit if anode and cathode should become shorted together.

SECTION 10

GLOSSARY OF ELECTRICAL TERMS

Appendix. Glossary of Electrical Terms.

Conductivity (c) The ratio of the density of the unvarying current in a conductor to the voltage gradient that produces it; common units of measurement are mhos per centimeter or siemens per centimeter.

Conductance (G) The measurement of the ability of a component to conduct electricity; the reciprocal of resistance; unit of measurement is the mho.

Current (I) The rate of electrical charge flow in a circuit. The practical unit is the ampere, which is one coulomb per second.

Current density (J) The ratio of a current to the cross-sectional area of its path in a plane perpendicular to the direction of the current.

Effective fish conductivity (c_f) The apparent electrical conductivity of live fish as determined by statistically fitting electroshock response data to the theoretical curve developed for the concept of constant power.

Electrical charge (Q) A fundamental property of matter that can be classified as a fundamental physical quantity. The practical unit is the coulomb. The electron, the smallest charge identified in nature, has a magnitude of 1.6×10^{-19} coulomb.

Mismatch ratio (q) The ratio of either the two resistance values or two conductivity values determined for adjoining media. For electrofishing, this is the ratio of conductivity of the water to the effective conductivity of the fish.

Power (P) The rate of doing work or the energy per unit of time. The practical unit is the watt, which is one joule per second.

Applied power (P_a) Power incident at an electrical interface separating two media.

Constant transferred power (P_m) The constant value of transferred power desired under all conditions of mismatch.

Maximum output power (P_M) The maximum available power delivered to an external load from a power source having an internal resistance equal to that of the external load.

Reflected power (P_r) The portion of applied power that is not transferred to the second medium.

Transferred power (P_t) The portion of applied power transferred from the first medium to the second medium.

Power density (D) The power or energy per unit of time dissipated in a given volume of material; the unit of measurement is watts per cubic centimeter.

Applied power density (D_a) Power density available for transfer to a fish at a particular location in the water.

Power density in fish (D_m) The desired constant value of power density to be transferred to a fish; also, the threshold of in vivo power density required to produce a specific electroshock response.

Resistance (R) The ability to react to the flow of AC or DC with an opposition to the flow of current. Also, the ratio of the applied voltage to the induced current that it produces. The unit of measurement is the ohm.

Resistivity (r) The reciprocal of conductivity. The common unit of measurement is the ohm-cm.

Volts or Voltage (V) The energy per unit of electrical charge. The volt is the unit of measure where one volt is one joule per coulomb.

Voltage gradient (E) The rate of change of voltage with distance. Also, the force per unit of electrical charge. The common unit of measurement is volt per centimeter.

Appendix C.1

Checklist for Electrofishing Safety and Health Audit

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APPENDIX C.1

CHECKLIST FOR ELECTROFISHING SAFETY AND HEALTH AUDIT

Item	Remarks	Yes	No
Safety Equipment	• Life preservers on board for each individual		
	• Leak-free electrical insulating gloves and boots available for each individual (NOTE: Gloves and boots should extend above the knees and elbows)		
	• Radio available for emergency contacts		
	• Radio property charged		
	• First aid kit in boat		
	• Burn Jel bandages available in first aid kit		
	• Personnel trained in first aid/CPR		
	• Fire extinguisher in boat (Type ABC 5 lb)		
	• Emergency air horn on board		
	• Funnel available for adding gasoline to generate or pump (NOTE: Gasoline should not be added to a hot motor)		
	• Polarized sun glasses		
Boat Safety	Lights available and working for night-time fishing		
	Boat equipped with an anchor		
	Boat in good repair free from sharp edges and weak or broken areas		
	Fuel tanks positioned a safe distance from the generator and battery (NOTE: Gasoline vapor cannot be allowed to contact hot surfaces or sparks)		
	Fuel tanks property capped and lines leak-free		
	Generator/pump shut-off switch available to eliminate grounding the spark plug		
	Generator/pump muffler facing outside the boat and shielded to prevent contact in rough seas		
	Foot pedal "dead man" switch controlling the flow of electricity in place in bow of boat (NOTE: Device must be operating for netter[s] to control)		
	If no netter foot pedal exists, is there another means of emergency generator shut off?		
	Probes used to extend the electrodes to the water made of non-conducting material		
	Electrical connections weather-proof and water tight		
	Electrical conducting surfaces connected to create one circuit on board (NOTE: Separate circuits create "floating metal" which can cause electrocution)		
	Surfaces checked with an OHM meter prior to launching the boat		

Item	Remarks	Yes	No
Trailer	• Trailer frame free of significant rust and structurally sound		
	• Hitch on trailer solid and working properly with locking hasp		
	• Two safety chains present that can be properly connected to the towing vehicle hitch		
	• Training stand secured properly and can be locked in the vertical and horizontal position		
	• Trailer stand and winch handles present and working property		
	• Safety chains present to secure boat to trailer during transportation (other than winch)		
	• Winch secure and in good working order		
	• Winch cable or rope free of broken strands		
	• Winch hook a locking type		
	• Trailer tires in good shape with adequate tread		
	• Trailer wheel bearings were greased (if not sealed)		
	• Lights on trailer working properly (brake and turning indicator)		
	• Trailer brakes working properly		
Motor	• Motor bolted to boat with four bolts		
	• Motor equipped with proper handles		
	• Motor can be properly locked in the “up” or travel position		
	• Emergency motor shut-off connected to operator in case operator falls from boat		
Post-Fishing Checklist	• Generator shut off during rain		
	• Boat operated free of sudden turns or changes in direction		
	• Comments and items needed for next trip		

Small Boat Operations SOP

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Standard Operating Procedure No. 035
for
Small Boat Operations

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 1
December 2014

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CONTENTS

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1. BACKGROUND

The threat from working on or near surface water bodies comes from both chemical hazards and physical hazards such as drowning. When there is a need for sampling to be conducted using small boats, EA will provide necessary safety gear, i.e., life vests, nets, and other floating devices and appropriate training.

1.1 PURPOSE

This Standard Operating Procedure (SOP) establishes the operating requirements for small boats conducting inland and coastal marine work.

1.2 SCOPE

This SOP applies to the operation of small boats, including launches, motorboats, working platforms, and skiffs, for inland (rivers, lakes, and bays) and coastal marine work. This SOP applies to EA personnel operating a small boat or working on a subcontractor-operated small boat. This SOP covers small boat requirements, work over or near bodies of water, personal floatation devices (PFDs), lifesaving and safety skiffs, severe weather precautions, and cold water and drowning hazards. This SOP is mandatory for EA personnel. Subcontractors are responsible for analyzing the hazards of activities they control and for preparing job hazard analysis and maintaining equivalent safety requirements.

1.3 DEFINITIONS

Small Boat—Includes dinghies, 1- or 2-man rowboats, up to and including larger vessels typically up to 50 ft in length, and work barges.

Float Plan—A written summary of the details of the trip, including route, type of vessel, persons aboard, and other salient information which may be useful in the event of an emergency.

Job Hazard Analysis—A concise analysis of the specific task considering the body of water, vessel, unique job requirements, training and experience of crew, and other circumstances as may be appropriate.

1.4 REFERENCES

EA Corporate Vessel Operations Manual. 2004. December.

Federal Requirements and Safety Tips for Recreational Boats. 1994. Boating Education Branch. April.

U.S. Army Corps of Engineers. 2003. Safety and Health Requirements Manual. Volume EM 385-1-1. September.

U.S. Coast Guard. 1994. Federal Requirements and Safety Tips for Recreational Boats.

1.5 RESPONSIBILITIES

The Project Health and Safety Officer is responsible for review and approval of small boat operations as described in the Health and Safety Plan. The Project Health and Safety Officer provides any necessary safety requirements to the project team. The Project Health and Safety Officer shall review the job hazard analysis prepared by project personnel.

Onsite Health and Safety Officer**—**The Health and Safety Officer is responsible for ensuring proper use of small boats at field locations. The Health and Safety Officer ensures that only trained personnel operate small boats, subcontractors implement safety programs, and that all equipment is properly maintained. The Onsite Safety Officer is responsible for filing or maintaining a float plan.

Small Boat Operators**—**EA personnel working on small boats will follow this procedure and any applicable health and safety procedures identified in the Health and Safety Plan and the vessel rules. Small boat operators will identify any conflicts in procedures or any problems or equipment failures to the Health and Safety Officer. Small boat operators shall demonstrate training, experience, and compliance with state requirements for operator education and licensing prior to operating any vessel. For larger bodies of water, or rapidly moving water, knowledge of local conditions shall be obtained prior to embarkation.

2. SMALL BOAT REQUREMENTS

All small boats used by EA personnel must meet the minimum requirements in the U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1 and the applicable Occupational Safety and Health Administration or state plan requirements, as well as meeting applicable U.S. Coast Guard Regulations. These requirements include the following:

- Small boats will meet the minimum floatation requirements of the U.S. Coast Guard, and must have a certification tag affixed to the hull.

- The maximum number of passengers and weight that may be safely transported must be posted on all small boats.

- The number of personnel on the small boat cannot exceed the number of Type I PFDs onboard.

- Each small boat will have sufficient room freeboard, and stability to safely carry the allowable number of personnel and cargo.

- Each motored boat measuring less than 26 ft in length will carry one 1A-10 BC fire extinguisher; motored boats measuring greater than 26 ft will carry two 1A-10 BC fire extinguishers.

Operators and occupants of small craft shall review Federal Requirements and Safety Tips for Recreational Boats (U.S. Coast Guard 1994) before engaging in work from rafts, dinghies, canoes, rowboats, or Jon boats.

2.1 WORK OVER OR NEAR WATER

Work over or near water, where the potential exists for personnel to fall in and possibly drown, will be conducted in accordance with the requirements of applicable Occupational Safety and Health Administration standards and the U.S. Army Corps of Engineers EM 385-1-1 standards. This includes work from shore, bridges, work platforms, and vessels. Work within 15 ft of unobstructed access to water is within the requirements of this section. Personnel will follow the guidelines listed below except where personnel are protected by continuous guardrails, safety belts, or nets, or are conducting work along beaches or similar shorelines:

- Personnel will use the buddy system at all times.

- Swimming is prohibited, with the following exceptions: (1) certified divers performing their duties, and (2) personnel entering water to prevent injury or loss of life.

- All personnel will wear a U.S. Coast Guard-approved PFD of the type able to support an unconscious person (Type 1 with 32-lb floatation).

- At least one Type IV throwable device (ring buoy, horseshoe buoy) will be available on the small boat. Throwable devices should be U.S. Coast Guard-approved and equipped with 150 ft of 600-lb capacity rope.

- If specified in the Health and Safety Plan, at least one person will provide a dedicated safety watch/look-out.

2.2 PERSONAL FLOATATION DEVICES

All EA personnel will wear a U.S. Coast Guard-approved, Type 1 PFD when working over or near bodies of water. PFDs should meet the following requirements:

- Before and after each use, the PFD will be inspected for defects that would alter its strength or buoyancy.

- All PFDs will be equipped with retro reflective tape.

PFDs need not be donned when working on larger craft (>26 ft) except when working over water or outside railing. PFDs should be worn at all times when working on smaller craft.

2.3 SAFETY EMERGENCY DRILL

The vessel operator shall provide a list of crew duties for normal operations and emergencies. Emergencies which shall be covered include man-overboard, vessel fire, and vessel emergency.

The vessel operator shall provide an orientation and emergency drill. An emergency drill shall be conducted at the start of each task, and monthly thereafter, or as provided for in U.S. Coast Guard regulations.

2.4 FLOAT PLAN

A float plan provides essential information to enable the U.S. Coast Guard or other emergency search and rescue teams to initiate a search in the event of personnel not reporting in on schedule. The vessel operator will file a daily float plan with the site representative and with the project health and safety representative listed in the Health and Safety Plan. Upon daily completion of on-water work, the vessel operator will check in with the designated on shore individual. The float plan is provided in Appendix A.

2.5 EMERGENCY PLAN

The emergency plan should list a main dock and an alternate dock, and provide emergency medical support contact for each location.

2.6 COMMUNICATIONS

A marine VHF radio shall be maintained onboard and in operable condition. At least one of the boat personnel shall have a mobile telephone onboard during operations.

2.7 OCEAN REQUIREMENTS

Contact the Corporate Health and Safety Officer and Project Health and Safety Officer prior to planning any work which requires work in open ocean.

2.8 SEVERE WEATHER PRECAUTIONS

During field operations involving small boats, EA personnel will make provisions for severe weather. Severe weather includes sudden and locally severe storms, high winds, hurricanes, and floods. Before beginning work over water, the Health and Safety Officer will evaluate weather reports and conditions to ascertain local weather and prevent personnel exposure to severe weather. In the event that severe weather is encountered, personnel will cease field operations and immediately return to shore.

2.9 COLD WATER AND DROWNING HAZARDS

EA personnel conducting field operations with a small boat may be exposed to cold water and drowning hazards. When water temperature is below 45°F, hypothermia is a serious hazard. A person can lose feeling in extremities within 5 minutes. Under no circumstances will EA personnel enter the water from a small boat unless conducting diving operations or performing a rescue.

Symptoms of hypothermia are discussed during standard first aid training and in the EA Health and Safety Program Plan. If a person who has fallen into the water displays symptoms of hypothermia, he or she should be treated immediately and the field operations canceled. Under no circumstances should the victim be given hot liquids, since they can accelerate shock. Drinks no warmer than body temperature are acceptable. If symptoms are severe and rapid evacuation is not possible, remove the victim's wet clothing and cover the victim with a blanket. Continue to treat the victim for shock.

When a high risk of cold water and drowning hazards exists, all field staff members should be familiar with cold water survival techniques. If a team member falls into the water, he or she should not remove any clothing in the water because all clothing will provide insulation. Although clothing creates added drag while swimming, the added insulation of the clothing outweighs the disadvantage of the additional drag.

If a team member falls into the water, another team member should try to reach the person in the water with an oar, paddle, pole, or similar object. The victim should try to grab the extended item. If the victim is unconscious, the rescuer should try to hook the victim's PFD, clothing, or hair and pull him or her toward the boat. Once the victim is retrieved, the other team members should begin any necessary emergency medical procedures. If no emergency medical procedures are necessary, the victim should change into dry clothing.

2.10 JOB HAZARD ANALYSIS

The requirements for preparing a job hazard analysis apply specifically to all on-water operations. Appendix B provides a sample job hazard analysis; however, an actual job hazard analysis shall consider the specific task including the body of water, vessel type, unique job requirements, training and experience of crew, and other circumstances such as tides, weather, water temperature, access of rescue craft, and other factors as may be appropriate. Job hazard analysis must be prepared specifically for each task and crew in accordance with the U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1.

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Appendix A

Float Plan

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APPENDIX A

FLOAT PLAN

1 Name and phone number of person filing plan.

2 Description of boat (type, color, trim, registration number, length, name, make, other).

3 Engine type (horsepower, fuel capacity, number of engines, and fuel [diesel or gasoline]).

4. Survival—Equipment onboard (check):

- Anchor
- Flares
- Flashlight
- Food
- Life ring with 150 ft of line.
- Paddles
- PFDs
- Smoke signals
- Water.

5. Marine Radio onboard (type, frequencies):

6. Automobile (tag number, type, color, make, trailer tag number, where parked)

7. Persons aboard (name, affiliation, and telephone number)

8. Do any of the persons aboard have a medical problem (identify type)

9. Trip plan (depart from @ time, arrive to @ time; via waypoints; expect to return no later than time)

10. Operational area (attach map)

11. If not returned by (a.m./p.m. time), call the U.S. Coast Guard or onshore contact.

12. Onshore contact:

Alternate Other Numbers

Contact	Number

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Appendix B

Job Hazard Analysis Form

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APPENDIX B

JOB HAZARD ANALYSIS FORM

Activity Hazard Analysis		
Task	**Potential Hazards**	**Hazard Control Measures**
MOBILIZATION/ DEMOBILIZATION	Physical Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways/work areas of equipment, tools, and debris. • Watch for accumulation of water work surfaces. • Mark, identify, or barricade obstructions. • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs.
	Physical Hazards (material handling moving, lifting)	• Observe proper lifting techniques. • Obey sensible lifting limits (60-lb maximum per person manual lifting). • Use mechanical lifting equipment (hand carts, trucks, etc.) to move large awkward loads. • Use two or more persons for heaving bulk lifting.
	Physical Hazards (vehicle and pedestrian traffic)	• Use orange traffic cones where necessary. • Use reflective warning vests if exposed to vehicular traffic. • Locate staging areas in locations with minimal traffic.
	Physical Hazards (cold/heat stress)	• Monitor cold/heat stress as recommended in Section 6 of the Generic Health and Safety Plan.
	Munitions and Explosives of Concern (MEC) Hazard	• Practice site reconnaissance with a trained, experienced MEC specialist capable of recognizing MEC hazards. • If MEC is discovered, use existing access roads to retract from the MEC.
	Biological Hazards (insects, poisonous plants, ticks)	• Wear protective outer clothing and insect repellant to avoid insect bites and ticks. • Wear long sleeve shirts when working in areas with poison ivy or oak. • Workers with allergies should carry antidote kits, if necessary.
SAMPLING ACTIVITIES	Physical Hazards (slips, trips, falls, cuts, etc.)	• Clear walkways/work areas of equipment, tools, and debris. • Watch for accumulation of water work surfaces. • Mark, identify, or barricade obstructions. • Wear cut-resistant work gloves when the possibility of lacerations or other injury caused by sharp or protruding objects occurs.
	Physical Hazards (electrical)	• Identify electrical utility hazards prior to sampling. • Inspect work areas for spark sources, maintain safe distances, properly illuminate work areas, and provide barriers to prevent inadvertent contact. • Maintain minimum clearance distances for overhead energized electrical lines as specified in the Generic Health and Safety Plan.
	Physical Hazards (weather)	• Monitor radio for up-to-date severe weather forecasts. • Discontinue work during thunderstorms and severe weather events.
	Physical Hazards (vehicle and pedestrian traffic)	• Establish an exclusion zone around the drilling location. • Use orange traffic cones (if necessary). • Use reflective warning vests if exposed to vehicular traffic. • Locate staging areas in locations with minimal traffic.

Activity Hazard Analysis		
Task	**Potential Hazards**	**Hazard Control Measures**
SAMPLING ACTIVITIES (continued)	Physical Hazards (cold/heat stress)	• Monitor cold/heat stress as recommended in Section 6 of the Generic Health and Safety Plan.
	MEC Hazards	• Follow established MEC avoidance protocols when performing intrusive sampling activities. • If MEC is discovered or suspected, use existing access roads to retract from the MEC.
	Chemical Hazards (including MEC)	• Perform environmental monitoring as required in the Site-Specific Health and Safety Plan. • Where appropriate, personal protective equipment as indicated in the Site-Specific Health and Safety Plan.
	Biological Hazards (bloodborne pathogens)	• Wear proper personal protective equipment, including nitrile gloves and a face shield or goggles when sampling sludge. • Wash with soap and water as soon as personal protective equipment is removed or when contact or exposure has occurred.
	Biological Hazards (insects, poisonous plants, and ticks)	• Wear protective outer clothing and insect repellant to avoid insect bites and ticks. • Wear long sleeve shirts when working in areas with poison ivy or oak. • Worker with allergies should carry antidote kits, if necessary.
BOATING ACTIVITIES	Physical Hazards (weather)	• Monitor radio for up-to-date severe weather forecasts. • Boat operators will be trained by the site supervisor and/or the senior boat operator. • Discontinue work during thunderstorms and severe weather events.
	Physical Hazard (slips, trips, and falls, including falls overboard)	• Boat operator will inspect the boat prior to operation. The operator will ensure the number of personal floatation devices is equal to or greater than the number of passengers onboard. • No personnel will embark or disembark the vessel without the direction of the vessel operator. Vessel operator will ensure passengers are wearing personal floatation devices while on deck. At the request of the operator, personnel will be seated. • Passengers will stay seated until boat is docked. Ensure three-point contact whenever possible or practical. • A Type IV throwable device will be readily available onboard.

Appendix H

Diving Safety Plan

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Dive Plan

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Military Munitions Response Program
Remedial Investigation, Iona Island Naval Ammunition Depot
Formerly Used Defense Site, New York

Diving Operations Plan

Prepared for:

U.S. Army Corps of Engineers

Baltimore District

Prepared for:

EA Engineering, Science, and Technology, Inc. PBC

255 Schilling Circle, Suite 400

Hunt Valley, MD 21031

Prepared by:

AOR International, Inc

3705 N. Courtenay Parkway

Merritt Island, Florida 32953

Military Munitions Response Program
Remedial Investigation, Iona Island Naval Ammunition Depot Formerly Used Defense Site, New York

I hereby certify that the enclosed Dive Operations Work Plan, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W912DR-15-D-0014, Delivery Order W912DR18F0587. This Work Plan is in compliance with contract specifications, Occupational Safety and Health Administration requirements, United States Army Corps of Engineers, Safety and Health Requirements Manual (EM 385-1-1, November 2014), and is submitted for Government approval.

Reviewed by:

Date of Submission: November 19, 2019

Plan prepared by:

Steve Mulholland	
Diving Program Manager	Signature
steve.mulholland@aorintl.com	(619) 559-5888

Title: Surface/subsurface MEC anomaly operations.

Location of operation: Old Navy loading docks, Hudson River, Iona Island, NY

Dates of field activity: August 2020 (Estimated)

Client: EA Engineering, Science, and Technology, Inc. PBC
U.S. Army Corps of Engineers – Baltimore District.

This Dive Operations Plan is divided into the following sections:

1.0 Dive Plan Overview

Section 1.0 provides names and duties of each member of the dive team and general safety policies.

2.0 Dive Task Operations

Sections 2.0 provide details on task specific operation including the mode of diving, breathing medium, ambient conditions and general sequence of activities and tasks.

Appendices:

Appendix A: Emergency Management Plan
Appendix B: Activity Hazard Analysis
Appendix C: Applicable Dive Tables
Appendix D: Safe Practices Manual
Appendix E: Personnel Certifications (To be provided once personnel are identified but prior to mobilization)
Appendix F: Air Purity (To be provided 1 week prior to mobilization)
Appendix G: Equipment Maintenance Logs (To be provided 1 week prior to mobilization)

"If for any reason the dive mission is altered in mission, dept, personnel, or equipment, the District Dive Coordinator (DDC) will be contacted in order to review and accept the alteration prior to the actual operation."

Table of Contents

Acronym and Abbreviations

ADCI	Association of Diving Contractors International
ACFM	Actual Cubic Feet per Minute
AHA	Activity Hazard Analysis
AOR	AOR International, Inc
ANSI	American National Standards Institute
ATA	Atmospheres Absolute
BC	Buoyancy Compensator
CFR	Code of Federal Regulations
CFM	Cubic Feet per Minute
CO2	Carbon Dioxide
CPR	Cardiopulmonary Resuscitation
DAN	Divers Alert Network
DDC	District Diving Coordinator
DOP	Dive Operations Plan
DPIC	Designated Person In-Charge
DSR	Dive Safety Representative
EAC	Emergency Assistance Checklist
EGS	Emergency Gas Supply
EM	Engineering Manual
EMI	Emergency Management Institute
EMP	Emergency Management Plan
EMS	Emergency Medical Service
EMT	Emergency Medical Technician
FFW	Feet of Fresh Water
FPM	Feet Per Minute
FSW	Feet of Sea Water
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HP	High Pressure
KMDSI	Kirby Morgan Diving Systems Inc.
KTS	Knots
LP	Low Pressure
MEC	Munitions and Explosives of Concern
MPPEH	Material Potentially Presenting and Explosive Hazard
OSHA	Occupational Safety & Health Administration
PMS	Planned Maintenance Systems
PPR	Pre-planned Response
PSIG	Pound Per Square Inch Gauge
RCC	Rescue Coordination Center
SCUBA	Self-Contained Underwater Breathing Apparatus
SPM	Safe Practices Manual

SSA	Surface Supplied Air
TBD	To Be Determined
USACE	United States Army Corp of Engineers
USCG	United States Coast Guard
USNDM	United States Navy Dive Manual
UW	Underwater

Section 1. General Diving Plan

1.1. DIVE PLAN DEVELOPMENT

This dive plan and related underwater operations will strictly conform to all regulations set forth in USACE Safety & Health Requirements Manual (2014), EM 385-1-1; U.S. Navy Diving Manual, Rev. 7. (2016); OSHA 29 CFR 1910, Subpart T; USCG Regulation 46 CFR 197 (Subpart B); and AOR International's Safe Practices Manual (SPM) for Underwater Operations.

AOR dive plans are prepared by the assigned DPIC/Diving Supervisor and reviewed by AOR International's diving program manager. All plans are submitted to the USACE District Diving Coordinator (DDC) for review and acceptance.

- Designated Person in Charge (DPIC)/Diving Supervisor,
- AOR Diving Program Manager Steve Mulholland,
- USACE DDC.

1.2. DIVE TEAM ASSIGNMENTS AND RESPONSIBILITIES

Each dive shift shall consist of a five-man team. Each member will be assigned to perform one or more of the responsibilities listed below. Names of the onsite team for dive operations will be provided.

All diving personnel have current diving certification records including dive logs, fit to dive physicals, and first aid/CPR cards, and oxygen administrator training. Only those individuals who have received approval by the DDC will be used in performance of this contract.

Dive stations will be manned by no less than a DPIC/Diving Supervisor, Diver, Standby Diver, one-Tender, and Boat Coxswain. All diving operations will be conducted during daylight hours.

1.2.1. DPIC/Diving Supervisor

Responsible for safe and efficient conduct of the entire job.

Primary: TBD **Alternate:** TBD

The DPIC/Diving Supervisor will have the following operations, safety and health related responsibilities:

1. Ensure that all diving and support personnel review and are aware of guidelines and procedures reflected in the Activity Hazard Analysis (AHA), Emergency Management Plan (EMP), and SPM for Underwater Operations.
2. Coordinate and supervise all diving and emergency operations.
3. Track diver's bottom time.
4. Liaison with the USACE Dive Safety Represnetative (DSR) and AOR Diving Program Manager and advise of safety and health matters related to the diving operations.

1.2.2. Diver:

Perform tasks as required and directed by DPIC/Diving Supervisor including the following specific tasks. **All divers are qualified to perform Stand-By diver or Tender duties as assigned.**

Divers: TBD TBD TBD TBD

1. Perform all diving duties appropriate to his qualifications as instructed by the DPIC/Diving Supervisor. If the job requires work beyond the experience or capabilities of the diver, the diver shall advise the DPIC/Diving Supervisor.
2. Follow safe diving practices at all times during diving operations, whether on deck or in the water. The diver must bring any points, issues and/or concerns pertaining to the job, dive safety and/or the dive operations to the attention of the DPIC/Diving Supervisor.
3. Comply with all AOR policies, procedures and practices as well as all regulations as they apply to divers' related qualifications or performance.
4. Perform techniques of the assigned diving mode.
5. Use UW tools, equipment and systems relevant to assigned tasks.

Note: *The standby diver will be rested, alert, and capable of performing immediate emergency rescue assistance and recovery. When work is limited to no decompression limits, the standby diver may have a previous dive and shall be sufficiently free of residual nitrogen to allow for 25-minute bottom time at the working depth without exceeding "No Decompression Limits."*

1.2.3. Tender

Assist diver with dressing and undressing, assist diver in and out of water, tend diver umbilical, operate equipment, and assist in topside work as required or directed by the DPIC/Diving Supervisor.

1.3 SAFETY POLICY

The DPIC/Diving Supervisor is ultimately responsible for the safety of all personnel and equipment working on the project and will report directly to the Diving Program Manager on all matters concerning the safety of diving operation.

The DPIC/Diving Supervisor will conduct daily tailgate safety meetings each morning prior to commencement of diving operations. Items of discussion will include coordination of the day's activities and a review of the Activity Hazard Analysis. All involved personnel, including the USACE DSR, shall attend the daily safety meetings. The USACE DSR, will be afforded an opportunity to address daily safety concerns and no work will be allowed to progress without their approval.

The site supervisor, if assigned, will conduct frequent safety inspections of the worksite, equipment and materials. Minor deficiencies will be corrected as soon as possible and discussed at the next tailgate safety meeting. Major deficiencies (imminent danger of harm to personnel of equipment) shall be cause for immediate cessation of work and correction of the issue.

After the completion of each dive, the DPIC/Diving Supervisor shall:

- Debrief each diver as to their physical condition.
- Instruct divers to report any physical problems or adverse physiological effects, including symptoms of decompression sickness or gas embolism.
- Ensure the diver knows the location of the nearest recompression chamber.
- Ensure each diver understands the potential hazards of flying after diving and remains within safe limits. Divers shall not fly within 12 hours of diving.

1.4 DIVING EQUIPMENT

Air certification for breathing air compressor will be available on site for inspection. (All equipment certification will be submitted to the DDC no later than 5 working days prior to start of work)

Equipment	Qty	Comments
KM18 Band Mask / KM37 Helmet	2	Hard wire communications
1st Stage Regulator with hose	2	EGS Bottle
EGS Tank (minimum 30ft^3)	2	Mounted on diver's harness
80-300 ft3 tanks/flasks (Breathing Air)	6	Primary and secondary
Harness (5 point)	2	
Air control box, 2 diver w/communications	1	
Divers Umbilical	2	200' min
Swim fins as required	2	Each diver
Divers knife	2	Each diver
Weight belt – as required	2	Each diver
Handheld magnetometer	2	
AxVIEW 2V-P Video recording system	1	Helmet mounted camera
Shark Navigation system	1	Monitor and assist Diver location
Compressor HP	1	Daily flask charging

1.2.4. Diving Platform

Diving operation will be conducted from a 'flat deck' aluminum pontoon boat or from shore. The dive boat will be a minimum length of 25'. The diving platform includes an operator's console, propulsion, anchoring/mooring, communications, required safety equipment and diver's ladder.

1.2.5. Topside assistance/support

No outside topside support will be required for this operation.

Section 2. Dive Task

2.1. DESCRIPTION OF WORK

AOR International is supporting EA Engineering, Science, and Technology, Inc., PBC with diving services for the MMRP Remedial Investigation at Iona Island Naval Ammunition Depot, Formerly Used Defense Site in Stony Point, Rockland County, New York. AOR will complete an underwater visual and analog detector survey of 3 former loading dock areas

The diving survey will be completed in Surface Supplied Dive Mode. Each diver will be equipped with an Emergency Gas Supply (EGS), a Shark Marine Navigation Tablet, and an underwater (UW) Ebinger 725K analog detector fitted with a 230 mm coil (or similar detector). Transects of each loading dock area will be pre-loaded into the Shark Tablet prior to diving operations. The Shark Tablet will be connected to a global navigation satellite system (GNSS) buoy for locating and tracking divers along transects.

After entering the water, the diver will use the Shark Tablet to navigate and investigate each UW transects. Planned routes will be displayed on the Shark Marine Navigation Tablet in one color for the diver to follow while actual diver's routes are plotted in another color. Route plotting and contact information will be recorded and reviewed daily and provided to USACE. Positioning information obtained through GNSS navigation will be recorded by the Shark Tablet and will allow the diver to visually follow his transect. The diver will investigate anomalies detected along each transect. Anomalies will be investigated by digging up to arms length. Non-munitions related debris will be left in place. Munitions Debris will be recovered. Material Potentially Presenting an Explosive Hazard (MPPEH) will be marked and photographed for evaluation. Following evaluation, MPPEH determined acceptable to move will be raised to the surface and taken to shore. MPPEH determined unacceptable to move will be blown in place in accordance with the Unified Federal Policy - Quality Assurance Project Plan (UFP - QAPP).

The dive contractor has identified the major phases of diving evolution completion as well as an overview of the daily workflow for this project below:

2.1.1. Phases for the project include:

- Mobilization of 5-person dive team and equipment to Iona, NY
- Site preparation/coordination with EA Engineering. Science, and Technology, Inc, PBC field team and USACE diving oversight
- Equipment preparation/inspection by diving inspector/DDC set-up, training, and performing check dives prior to diving operations
- MEC subsurface anomaly RI (details incorporated in QAPP)
- Work completion /debrief to ensure all project deliverable data has been acquired
- Demobilization of the 5-person dive team and equipment to original destination.

2.1.2. Daily Work Schedule

- Daily safety / dive brief (diving assignments, safety information specific to day's activities)
- Dive station and emergency equipment pre-staging

- MEC anomaly RI operations
- Daily debrief.

Dive logs shall be submitted to the DDC as requested.

2.2. DATE, TIME AND LOCATION OF DIVE OPERATIONS

Diving Operations will typically be conducted 0700-1700 each day during daylight hours to allow for work schedule adjustments, as may be required due to inclement weather. In general, it is anticipated that the dive schedule will consist of:

07:00 AOR Team arrive and perform pre-maintenance inspections and checks. The dive sup will ensure all safety and emergency measures are in place, conduct muster and daily tailgate safety brief followed by the dive brief.

07:30 AOR Team underway to the project footprint/dive site and commence MEC anomaly RI diving operations.

16:30 AOR Team secure from diving operations. AOR Team conducts post-dive maintenance inspections and checks, dive sup conducts team de-brief and prepares for the next day's operations.

2.3. DIVING MODE. (INCLUDING A DESCRIPTION OF THE BACKUP AIR SUPPLY.)

The diving mode shall consist of a commercial SSA system utilizing HP air for primary and secondary air supply. Two (2) each, 200-foot or greater, diving umbilical's will be used to provide breathing medium to the divers. All diver umbilical's will be attached via the diver(s) air control manifold to allow for cross connection of primary and secondary supply to the diver(s) as required.

A single dive crew will be used to execute this phase of the work. The dive station will be set up on AOR's dive boat for diving operations. Diver(s) will enter and exit the water via a ladder suspended over the boat(s) side. A 4-pin hardwire communication system will provide communication between the divers and the divers to the dive control station. Divers will be equipped with a helmet mounted underwater color camera which will be displayed on monitors in the video systems console at all times. Digital video recorder will be connected inline and will be recorded as required.

All dives will be planned for No "D". Primary means of selecting the diver's decompression schedule will be conducted by utilizing US NAVY Dive Tables. The DPIC/Diving Supervisor is responsible for tracking the diver's No "D" time remaining via a stopwatch on the surface. Repetitive dives at shallower depths are allowed if for any reason voice communications are lost, the dive must be aborted. Line pull signals will used to communicate during a loss of voice communication.

2.3.1. Backup Air Supply

Divers will utilize a Kirby Morgan Mask/Helmet fitted to accept an EGS bottle. Divers will use a minimum of a 30 ft3 EGS bottle with its own 1st stage regulator attached to the

KM Mask/Helmet side block manifold. The Dive Sup must ensure the back-up air supply is fully charged with a minimum of 2700 psig or at planned depth will provide the diver with a minimum of 12-minutes of air during an emergency with a diver breathing rate of 1.4 ACFM.

2.4. NATURE OF WORK TO BE PERFORMED BY THE DIVERS, INCLUDING TOOLS USED AND MATERIALS TO BE HANDLED OR INSTALLED:

The Dive Team will be conducting subsurface MEC anomaly RI operations utilizing the diver's handheld magnetometer. The team will mark MEC anomalies location with GPS and if conditions allow a weighted buoy for visual reference and recovery.

If standby diver is utilized as a working diver, the primary diver must report that the worksite is free and clear of obstructions and the diver has free access to the surface. Pre and post-dive maintenance, inspections and checks will be performed on each diving day.

2.5. ANTICIPATED SURFACE AND UNDERWATER CONDITIONS

- Air Temperatures range from a low of 40 degrees F and to highs from 80 degrees F.
- Surface conditions: Winds from the SE @ 1kt.
- Underwater conditions: Foliage and industrial debris
- Currents: 1kt plus
- Visibility: 0 - 1 foot
- Temperature: Water temperatures of 50 - 60 degrees F are expected.

2.6. MAXIMUM SINGLE DIVE BOTTOM TIME FOR THE PLANNED DEPTH OF DIVE FOR EACH DIVER:

Maximum Depth = 60 FFW. Depth measured by pneumofathometer on the console, correction to depth measurement is required.

Elevation at dive site = 08 feet.

Maximum single dive bottom times shall not exceed:

No Decompression Limit for 60' FFW = 63 minutes.
No Decompression Limit for 45' FFW = 125 minutes.
No Decompression Limit for 25' FFW = 1102 minutes
No Decompression Limit for 20' FFW = unlimited

2.7. MEANS OF DIRECT COMMUNICATION:

The primary mean of communications between AOR DPIC/Diving Supervisor, District Safety Representative, EA PM, SUXOS, UXOSO and USACE PM, and the dive site will be by cellular phone. Secondary means will be either by messenger in the event of an emergency.

2.8. CONTRACTOR INFORMATION

Organization	Role	Name	Phone Number
EA Engineering	Prime Contractor	Tim Reese	410-935-3887
AOR International, Inc	Diving Technical Manager	Brandon Puttroff	619-203-7325
AOR International, Inc	Diving Program Manager / DPIC	Steve Mulholland	619-559-5888

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Safe Practices Manual

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2016

SAFE PRACTICES MANUAL FOR UNDERWATER OPERATIONS

PREPARED BY: STEVE MULHOLLAND

FOR INTERNATIONAL

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Appendix List

DOCUMENT APPROVALS

Document Number:

Document Title: Safe Practices Manual for Underwater Operations – Revision Approvals

Revision #	Description	Prepared By	Reviewed By	Approved By	Date
0	**Safe Practices Manual**	Cliff Morin	John Hatcher	Trent Milligan	12-20-2016
1	**App. F – Dive and Treatment Tables**	Trent Milligan	John Hatcher	Trent Milligan	03-12-2017

REVISION HISTORY

Rev.	Section	Date	Amendment Description

1.0 INTRODUCTION

1.1 SCOPE AND PURPOSE

Diving operations involve a unique combination of occupational health and safety issues performed in an unforgiving environment where errors can quickly develop into serious incidents. Individual risks must be managed if diving is to be conducted in a safe and efficient manner.

1. This Safe Practices Manual for Underwater Operations defines the principles and requirements of surface diving operations performed by AOR International, INC. (AOR). The purpose of this manual is to define AOR safe practices for diving operations to ensure that these activities are planned, organized, performed, documented, and verified in a safe and efficient manner.

2. This manual replaces and supersedes all previous safe practice manuals and/or safety memorandums. It will be made available at each dive site for reference purposes and is to be used in conjunction with the documents listed below in **Section 1.2**.

3. It should be understood that there may be times when compliance with these rules could cause unsafe conditions and a variance will be necessary. As a minimum standard, such deviations should always be on the side of increasing safety. The reasons for any deviation and steps taken to minimize or eliminate risk shall be documented and approved by the **AOR Diving Operations Manager** and **Compliance, Health & Safety Manager**.

4. Every employee must keep in mind that no safety standard or set of rules will ever exist that will substitute for sound judgment and a continuing concern for optimum safety.

   The Diving Supervisor shall contact the AOR Diving Operations Manager and Compliance, Health & Safety Manager in the event of a situation not covered by procedures described in this manual, or where these procedures cannot be applied due to operational, health, safety, or reasons or due to local legal or contractual requirements.

1.2 REFERENCE DOCUMENTS

The following documents were used as reference for this manual and may be used for further clarification:

A. Occupational Safety and Health Administration (OSHA) Part 1910 – Occupational Safety and Health Standards, Subpart T, Commercial Diving Operations (Current Revision)

B. Occupational Safety and Health Administration (OSHA) Directive Number: CPL 02-00-051 (effective date: January 29, 2016)

C. US Navy Diving Manual Rev. 7 SS521-AG-PRO-010 0910-LP-115-1921, December 01, 2016

D. The Association of Diving Contractors International, Inc. (ADCI) Consensus Standards for Commercial Diving and Underwater Operations Rev. 6.2, Sixth Edition, 2016

E. AOR International, INC. – Health and Safety Standards & Implementations Manual (Current Revision)

F. US Army Corps of Engineers Safety and Health Requirements Manual, Regulation number EM385-1-1, 30 November 2014

G. Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel DDESB TP-18, 01 September 2016
H. Guidance for Diving in Contaminated Waters Revision 1, SS521-AJ-PRO-010, March 15, 2008

1.3 PRESERVATIVE ACTS DISCLOSURE

It is expressly provided and declared that in an emergency situation where personnel or environmental safety is at risk, the company, its officers, directors, agents, or employees may act in variance with the operating procedures and recommendations established in this Safe Practices Manual.

1.4 RESPONSIBILITY FOR ESTABLISHMENT AND MAINTENANCE OF THE MANUAL

A. The AOR Diving Operations Manager is responsible for establishing and maintaining this document.

B. Personnel employed by AOR International are responsible for adhering to the procedures and policy set forth in this manual and for providing feedback aimed at its continual improvement.

1.5 IMPORTANT DEFINITIONS

A. “Shall” is used for mandatory actions and requirements of design, calculations, planning, etc., to comply with specifications. With regard to its use in this manual, “shall” is equivalent to “must.”

B. Important technical definitions are presented in ***Appendix H - Glossary***.

C. He/she – This is a gender-neutral document. Any reference to he or she implies either.

2.0 PERSONNEL REQUIREMENTS

2.1 ASSIGNMENT AND RESPONSIBILITIES

Titles, duties, responsibilities, and capabilities of personnel engaged in commercial diving and underwater operations vary widely across the industry. AOR has established functional descriptions for all positions in its subsea operations. The AOR Diving Operations Manager is responsible for assigning personnel to key positions in the company's underwater diving operations and will ensure all persons are qualified by training and experience to perform the tasks assigned. The following designations indicate the minimum duties and responsibilities of dive team members:

A. Each manager/supervisor is responsible for the health and safety of their employees and all safety/environmental activities within their area of supervision.

B. Each employee shall demonstrate a positive attitude toward injury prevention and protection of the environment and company property. Each employee shall accept that all injuries can be prevented. For more information, refer to the AOR Health and Safety Standards and Implementations Manual.

C. Effective management can be achieved only through good communication and complete understanding of the role of each individual in a project's organization. Therefore, it is essential that each employee is competent and qualified with their individual duties and responsibilities.

D. Job descriptions state the responsibilities and authorities assigned to persons holding a particular position and detail the most important functions relevant to that position. All persons shall have the necessary qualifications for their job assignments.

E. Diving personnel shall have valid documentation of training in relevant subjects, i.e., certificates or documentation from a school that instructs at American National Standards Institute/Association of Commercial Diving Educators (ANSI/ACDE) 01-2009 standards or is approved by the ADCI, a military diving school, or equivalent. Personnel previously employed without meeting these qualifications must be certified by the company as having an equivalent degree of training though a combination of field experience and formal classroom instruction. It is each employee's responsibility to provide all records pertaining to qualifications for their assigned job function(s) to AOR.

F. Persons assigned to specific diving activities shall possess the following knowledge and skills gained through training or experience:

   1. Diving procedures and techniques;
   2. Emergency procedures;
   3. Physiology as it relates to diving;
   4. Diving equipment;
   5. Basic first aid/CPR (per regulations);
   6. Emergency Oxygen provider;
   7. Familiarity with procedures and proficiency in the use of tools, equipment, and devices associated with the assigned tasks; and
   8. Knowledge of chamber operations (If applicable).

G. A person lacking the required experience and proficiency outlined above may be assigned limited tasks, under the direction of an experienced and qualified individual, in order to obtain the experience and level of proficiency required.

H. Persons engaged as divers or otherwise exposed to hyperbaric conditions shall meet the physical qualifications for such activities as outlined in **Section 4.0 Medical Requirements**. Such physical qualifications shall be documented on an ADCI Medical History and Physical Examination Form or equivalent issued by AOR's Work Care provider.

2.2 ORIENTATION TRAINING

2.2.1 General Orientation Program

A. Each individual shall complete an orientation program when first hired on and prior to commencing work at an AOR worksite. The orientation program is established to ensure that personnel are familiar with all information necessary to conduct the planned operations.

B. The orientation program consists of OSHA, USACE and company-required training, including AOR's H&S specific program standards training. Records including the content of such training, duly signed off, must be maintained in the individual's training file, and relevant records must be accessible to supervisory personnel.

2.2.2 Job Site Orientation

Each job and situation has its own requirements, and reason and logic should normally prevail in the definition of the orientation training. The diving Supervisor is ultimately responsible for assuring that personnel assigned to their respective teams have been given a satisfactory job-site orientation before starting work.

2.3 ENTRY LEVEL QUALIFICATIONS

A. The entry level, minimum skill designation on the diving team is the entry level tender. The entry-level tender shall satisfy the minimum entry qualifications of diving proficiency, technical proficiency, and experience by successfully completing a course of study approved by AOR Diving Operations Manager.

B. A formal course of study for a tender/diver shall be completed at any accredited school, military school or equivalent whose curriculum at a minimum, conforms to ANSI/ACDE- 01-2009 (ANSI American National Standard Institute and ACDE – Association of Commercial Diving Educators). This training for commercial diving is comprised of at least 625 documented hours of academic and practical training components.

C. AOR International recognizes formal training certificates issued from within other nations. Foreign certificates will be evaluated together with presented other documentation to determine if the individual satisfies minimum entry requirements.

D. For persons engaged as divers, or otherwise subjected to hyperbaric conditions, an initial diver medical examination is required. See **Section 4.0 Medical Requirements**.

E. Advancement to higher job skill designations shall require completion of training and experience for all lower designations. Additional required technical qualifications for various job skill designations are detailed separately in **Section 3.0 Individual Qualifications, General Duties, and Responsibilities'**.

F. An individual must demonstrate the following field experience and diving proficiency and be competent and qualified before being promoted from tender to diver:

1. Air divers: Minimum of 60 field days and 20 working dives;

2.4 FIELD EXPERIENCE

Field experience shall be defined as the number of field days an employee has directly participated as a diving supervisor, diver, or tender engaged in diving operations. Individuals must meet the minimum established field experience requirements to obtain various skill designations.

2.5 DIVING PROFICIENCY

Diving proficiency shall be determined by the number of open-water working dives performed by an individual during a 12-month period immediately prior to issuance of a particular job skill designation. Individuals must perform the minimum established number of working dives for each skill designation. Work shall be performed during each dive with proper supervision, and all dives shall have a minimum of 20 minutes of bottom time.

2.6 COMMERCIAL DIVER CERTIFICATION PROGRAM

Persons employed to perform as certified commercial divers must be properly trained in accordance with the current edition of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations. All diving personnel need to hold a current ADCI certification card reflective of the assigned task and experience level.

ADCI Certification Cards can only be obtained through application to ADCI upon company verification of acceptable documentation that the individual has completed the requisite training and on-the-job experience necessary to support the appropriate classification level.

Table 2.1 lists the certification exams, experience level, and pre-requisites for each dive team member category.

Table 2.1 Certifications and Training Matrix

REQUIREMENTS	ENTRY-LEVEL TENDER/DIVER	AIR DIVER	AIR-DIVING SUPERVISOR
Formal Training	625 hours		
Field Days		60	120
Working Dives		20	60
Assistant Supervisor Training Field		30 working days	
Exam			Exam Required

2.7 PERSONAL DIVER LOG BOOKS

2.7.1 Log book Maintenance Responsibilities

A. All divers shall maintain a personal dive log (ADCI Professional diver's logbook or equivalent) detailing all hyperbaric exposures. The logbook shall include a photograph of, signature, and home address of the diver maintaining the log. This logbook shall be presented for review upon hire and upon request during employment.

B. At a minimum, the following information should be entered in the log book for each dive:

1. Local office name and address;
2. Date of the dive;
3. The name or other designation and location of the dive site or vessel from where the diving operation was carried out;
4. Maximum depth reached during the dive;
5. The time left surface, total bottom time, and the time reached surface for each hyperbaric exposure;
6. Surface interval, if dive includes chamber time for decompression;
7. Type of breathing apparatus and mixture used;
8. Task performed;
9. Type and designation of the decompression table and schedule used;
10. Any decompression illness (DCI) or injury incurred during the dive;
11. Comments section;
12. Diver's signature;
13. Supervisor's signature; and
14. Place for a counter-signature or stamp of the diving company.

C. Divers shall, in addition to the above requirements, maintain a log of any and all maintenance performed on personally owned equipment. Records of this maintenance shall include the following minimum information:

1. Name of person conducting the maintenance;
2. Date of maintenance; and
3. Work performed.

D. All diver personnel shall present their personal logbook to company authorities for verification and stamping at annual intervals, at a minimum.

2.7.2 On-site Verification of Personal Log book

All divers shall present their personal logbook at the work site. The diving supervisor shall verify that all divers assigned a diving role have a current and up-to-date logbook that meets the criteria in **Section 2.7**.

3.0 INDIVIDUAL QUALIFICATIONS, GENERAL DUTIES, AND RESPONSIBILITIES

Table 3.1 Job Titles, Abbreviations, and Descriptions for Surface Diving Personnel

Abbreviation	Job Title	Description
Supervisors		
DST	**Superintendent - Diving**	**Superintendent – Surface-Supplied Diving. Qualified to supervise multiple shifts and vessel operations.**
DS	**Diving Supervisor – Air**	**Diving Supervisor – Surface-Supplied Diving. Qualified to supervise only air diving (completion of Supervisor Training Program for Air Diving).**
Divers/Tenders		
UXOD1	**UXO Diver I**	**In addition to air diving- UXOD1 is able to search and report UXO findings and assist UXOD2 in demolition of UXO**
UXOD2	**UXO Diver II**	**In addition to air diving- UXOD2 is able to evaluate, handle and effect demolition on UXO.**
SSAD	**Air Diver**	**Fully qualified to dive operationally to 165 FSW.**
STBD	**Standby Diver**	**Lowest level of training and experience for Diver classification ("breakout" to SSAD qualifies for promotion by supervisor and management evaluation and requires completion of 20 working dives as a Tender).**
DT	**Tender**	**Tender (apprentice diver): Qualified for surface-supplied air diving. +6 months or +60 days in field.**
Technicians		
Rack Operator	**Rack Operator**	**Dive team experience and qualified to operate the particular breathing manifolds, regulators, and valves, which control the breathing medium to the diver(s). Can monitor depth and pressure gauges for entry into diving log. Works under the direct supervision of the diving supervisor.**
Dive Tech	**Diving Equipment Technician**	**Surface-supplied diving equipment. Qualified to inspect, maintain and repair diving equipment, diving helmets, testing and certifying equipment, regulators, gauges, valves, etc.**

3.1 DESIGNATION OF PERSON-IN-CHARGE OF DIVING OPERATIONS (DPIC)

A. A qualified person in charge of each diving operation shall be designated as the diving supervisor, or designated Person-in-Charge of Diving Operations, by means of written documentation. A copy of the documentation shall be available to competent authorities on arrival at the work site. This notification is provided in accordance with the following regulations:

1. USCG 46 CFR Part 197 Subpart B: Commercial Diving Operations, 197.210 Designation of Diving Supervisor

2. OSHA 29 CFR Part 1910 Subpart T: Commercial Diving Operations,1910.410(c) Designated Person-in Charge

B. The DPIC (Designated Person-in-Charge), commonly referred to as the "Diving Supervisor," is immediately responsible for the safety and health of the dive team. The DPIC is the employer representative chosen by the employer. The DPIC shall be stationed at the dive location, and shall not be stationed at another dive location (i.e., he/she must be stationed at one dive location and be responsible only for the diving operation at that location). The DPIC has the authority to permit the start of diving operations. The DPIC has the ultimate authority to forbid the start and to order the termination of any diving operation on the grounds of safety.

3.2 DIVING SUPERINTENDENT

A. Qualifications

1. The diving superintendent shall have a thorough knowledge of the dive system and relevant equipment, including related operational and emergency procedures; familiarity with relevant regulations applicable to diving venue; familiarity with relevant standards/guidelines applicable to diving venue. He shall also have sound knowledge of the AOR Health and Safety Management System and this Safe Practices Manual for Underwater Operations. Additionally, the diving superintendent must be competent and qualified in the following areas:

    a) Diving procedures and techniques in use at the specific work site;
    b) Management of diving incidents;
    c) Emergency procedures;
    d) Diving-related physiology;
    e) Proper operation and use of all equipment related to diving, including decompression chamber operation;
    f) Hazard recognition and risk assessment; and
    g) Management of Change and Variance processes.

2. In addition, the diving superintendent shall attend scheduled pre-job meetings and/or assist in the risk assessment, as required.

B. General Duties

1. The diving superintendent is in charge of leading the planning and execution of the diving operations and must be competent and qualified.
2. The dive superintendent reports to the project manager and maintains close communication with the client's representative.

C. Responsibilities

The diving superintendent has the responsibility to:

1. Supervise all operational activities, including ship deployment preceding and during any diving, and/or diving equipment on board the ship, barge, or jobsite;
2. Maintain quality control of all operational activities in accordance with the relevant standards and specifications, as required by the client's representative and project documentation requirements;
3. Ensure that all diving operational activities undertaken are in accordance with operational manuals and safety memoranda;
4. Ensure that all employees and/or subcontractors on the diving jobsite follow the EHS policies;
5. Ensure that personnel arriving on the jobsite are fully briefed about the work program, dive systems, and operational and safety requirements;
6. Ensure that any permit-to-work system is fully complied with;
7. Ensure that a safety meeting is convened at the prescribed intervals and a copy of the minutes is sent to the responsible AOR project manager;

8. Coordinate daily pre-shift safety meetings with the diving supervisors;
9. Implement any corrective measures as defined by documented audits and/or inspections pertaining to personnel, the work site, and supporting equipment;
10. Report incidents, near misses, dangerous occurrences and other information to the AOR Compliance, Health and Safety Manager;
11. Prepare or delegate the daily report required by the project manager; and
12. Know the procedures for the Emergency Management Plan for evacuation of the jobsite.

3.3 DIVING SUPERVISOR

A. Qualifications

1. The diving supervisor shall have a thorough knowledge of the system and relevant equipment, including related operational and emergency procedures; familiarity with relevant regulations applicable to diving venue; familiarity with relevant standards/guidelines applicable to diving venue. The diving supervisor shall also have a sound knowledge of the AOR Health and Safety Standards and Implementation Manual and the Safe Practices Manual for Underwater Operations. Additionally, the diving supervisor must competent or qualified in the following areas:

    a) Diving procedures and techniques in use at the specific work site;
    b) Management of diving incidents;
    c) Emergency procedures;
    d) Diving-related physiology;
    e) Proper operation and use of all equipment related to diving, including decompression chamber operation;
    f) Hazard recognition and risk assessment; and
    g) Management of Change and Variance processes.

2. The diving supervisor shall be designated in writing as the Person-in-Charge of Diving Operations.

B. General Duties

1. The diving supervisor has the responsibility for the safe implementation and completion of the diving operations under his command. He must operate within the all regulations and AOR procedures unless an approved variance is in place.
2. The diving supervisor is appointed in writing and reports to the diving superintendent or project superintendent where one is assigned. In the event a Diving or project superintendent is not assigned, the diving supervisor reports to the project manager.

C. Responsibilities

The diving supervisor has the responsibility to:

1. Manage all aspects of the dive site, properly direct the dive team members in the performance of their duties, and remain ready to respond to emergency conditions;
2. While on duty, be in immediate control and available to implement emergency procedures. The diving supervisor shall have no duties other than those set forth in this document and is not permitted to dive unless another qualified diving supervisor is present who has been appointed and designated to assume responsibility;
3. Possess such qualifications that are deemed necessary by AOR and this Safe Practices Manual;
4. Assign the duties of all members of the dive team and ensure they are competent and qualified to carry out their tasks;

5. Verify that all personnel on the dive team are qualified and physically able to perform tasks assigned (i.e., must make an assessment of physical condition of the Divers prior to each dive to determine if any physical impairment is present that would be detrimental to their health and safety in the water or under hyperbaric conditions;
6. Establish a dive plan ensuring that sufficient breathing mixtures, supplies, and proper equipment are available for safe and timely completion of the task;
7. Ensure that an Activity Hazard Analysis (AHA) is performed for each task associated with the diving operations;
8. Be aware of procedures to obtain medical support in the event of an incident (both diving and non-diving);
9. Attend scheduled pre-job meetings and/or assist in risk assessment, as required;
10. Conduct and attend effective pre-shift safety meetings with dive team and support personnel to cover, such as:
    a) Tasks to be undertaken, and
    b) Unusual hazards and environmental conditions

11. Instruct divers to report any illnesses, infections, or anything unusual that would interfere with the safe completion of their dive. Also, instruct divers to report any symptoms that might indicate DCS or injury following a dive;
12. Ensure that the diver's pneumo hose does not become clogged with sand or mud while working in such conditions on bottom. It is a recommended practice to do a slow purge of the pneumo hose after an accurate depth is established. This practice should be addressed and taken into account when performing the pre-dive AHA;
13. Report all injuries and incidents involving personnel as required by AOR and the client;
14. Inform the diving superintendent or project manager of his intentions in order to maintain effective liaison between all interested parties;
15. Complete all records and documentation, regularly and in full, as required by relevant industrial standards, AOR procedures, and this Safe Practices Manual, including requirements for diving operations, equipment maintenance, testing, and repair;
16. Assure adequate turnover and fully brief his relief on the operation, regardless of the period of absence from the supervising position;
17. Keep an accurate personal diving supervisor log book as well as review and ensure accuracy of divers' log books and sign to properly record activities;
18. Review and implement emergency contingency procedures;
19. Conduct routine diving emergency drills and record accordingly;
20. Facilitate "pre and post" dive checklists for the operations;
21. Brief diving teams before each dive;
22. Ensure that all relevant operating instructions, manuals, decompression tables, and treatment schedules are available at the dive location and are maintained to reflect current changes;
23. Ensure that all equipment is placed at the work site with regard to ease of operation and safety;
24. Ensure that all necessary supplies and equipment have been provided, are suitable for purpose, and are inspected prior to dive;
25. Ensure that the diving operations are conducted from a suitable and safe location on the surface;
26. Ensure that each diver is continuously tended in the water;
27. Determine deepest depth of dive prior to leaving bottom.
28. Ensure that the dive is terminated when:
    a) the diver requests termination;
    b) the diver fails to respond to communication or communication is lost;
    c) the diver goes on bailout (diver-carried emergency gas system); or
    d) weather conditions or site conditions degrade to the extent that diver safety is in jeopardy.
29. Ensure each diver surfacing from a dive requiring decompression is assessed for the following:

a) The physical condition and well-being of the diver is checked by visual observation and verbal questioning;
b) The diver is instructed to report any physical problems or symptoms of DCS.

30. Ensure that after any treatment or dive outside of the no-decompression limits:
    a) The diver is instructed to remain awake and in the vicinity of a decompression chamber for at least 2 hours, and
    b) A trained dive team member is available to operate the decompression chamber;

31. Ensure each diver's personal equipment is inspected and is safe for use. Personal gear that is not within specifications or is deemed "unfit for use" shall not be used;
32. Maintain required medical certification (i.e., first aid CPR, and O2 administrator);
33. Ensure instruction is given to tenders while making dives to allow them to gain much needed knowledge and experience on their way to becoming divers.

3.4 NON-DIVING SUPERVISOR

A Non-diving supervisor is an experienced diving supervisor not currently participating in the diving rotation. In the event the diving supervisor will dive in the rotation, he must appoint another person to act as diving supervisor who has adequate qualifications of a diving supervisor.

3.5 UXO DIVER I

A. Qualifications

1. Divers shall have a thorough understanding regarding the equipment and tools to be used during the work. They shall have a sound knowledge of the operational and emergency procedures relevant to their work. Additionally, divers shall h a v e training or experience in the following areas:

    a) Air diving procedures and techniques, and, if applicable, mixed gas diving procedures and techniques;
    b) Emergency procedures;
    c) Management of diving incidents; and
    d) Proper operation and use of all equipment related to air diving, including decompression chambers.

2. All divers must meet the required standards from an ACDE accredited school, a school that instructs at ANSI standards level or is approved by the ADCI, a military school, or equivalent approved by AOR.
3. Completed the underwater portion of NAVSCOLEOD (or foreign equivalent)

B. General Duties

1. The diver must read and comply with all AOR policies, procedures and practices as well as all regulations as they apply to divers' related qualifications or performance.
2. The diver must possess an ADCI/or local equivalent-approved current medical clearance to dive and a current logbook ADCI Professional Diver's log book or equivalent). This logbook is to be kept up-to-date.
3. The diver is expected to perform all diving duties appropriate to his qualifications as instructed by the diving supervisor. If the job requires work beyond the experience or capabilities of the diver, the diver shall advise the diving supervisor.
4. The diver is expected to follow safe diving practices at all times during diving operations, whether on deck or in the water. The diver must bring any points, issues and/or concerns

pertaining to the job, dive safety and/or the dive operations to the attention of the diving supervisor.

C. Responsibilities

The diver has the responsibility to:

1. Keep in good physical condition;
2. Comply with all policies, procedures and/or practices of AOR and any applicable government agency;
3. Inform the diving supervisor if he is unfit, has a condition and/or or if there is any other reason why he should not go or remain under water or in a decompression chamber. He must report any recent illness or medical treatment and advise the diving supervisor of any prescription drugs or medication he is taking so that a determination can be made to his ability to dive safely; any current/ongoing symptoms/illnesses are to be made known when diver reports to the jobsite and immediately before a dive.
4. Report any illnesses, symptoms or injury pre and post dive immediately to the diving supervisor;
5. Check all basic diving equipment that he would normally use on a dive, including any emergency equipment, ancillary equipment, or personal protective equipment (PPE). Before entering the water, and he should be satisfied that his equipment is functional and in proper working order;
6. Report to the diving supervisor any defective or malfunctioning diving equipment provided for the diving operation;
7. As required, assist in the setup, maintenance, and repair of all diving equipment on the job;
8. Comply with regulations or instructions concerning the use, repair, maintenance, and testing of all diving equipment provided for the operation;
9. Act as standby diver when required and following all requirements found in *Section 3.8;*
10. Ensure that he is fully briefed prior to a dive and fully understands the task to be carried out;
11. Report the exact condition of the work site to the diving supervisor, including any hazards that might exist for the divers who follow in rotation;
12. Make certain the deepest depth of dive has been established prior to leaving bottom;
13. Obey the diving supervisor when instructed to depart the work site for a return to the surface or the first water stop;
14. Safely exit the water and make a timely transition into the decompression chamber within the prescribed time limit, as noted in the air/gas surface diving tables;
15. Remain awake in the vicinity of the decompression chamber for a minimum of 2 hours after the completion of each dive, decompression, or treatment;
16. Ensure, on completion of a dive, that his equipment is cleaned and stowed and that any equipment faults are brought to the attention of the diving supervisor;
17. Review the dive sheet within the calendar day of the dive and ensure correctness. Any discrepancies are to be reported to the diving supervisor for appropriate action. The diver is to sign the dive sheet after review;
18. Comply with the facility safety requirements;
19. Be able to apply the routine emergency procedures that are detailed in the relevant manuals on board;
20. Immediately report any incident, injury, illness, symptom and/or feeling unwell to the diving supervisor and/or dive superintendent before dive, during dive, during surface interval and post dive;
21. Know and observe the rules for time limitations of flying after diving;
22. Not to do heavy lifting with an hour of surfacing from a decompression dive;
23. Maintain a diver’s log book that details all dives, medical examinations, courses taken, certification level achieved, and personal equipment maintenance;
24. Ensure medical certifications are up-to-date and recorded in a personal log book;

25. Present their log book to the diving supervisor on every job for his signature following a dive;
26. Maintain certification in first aid, CPR, and O2 administration;
27. Have experience in the use of diving equipment;
28. Be familiar with the type of work at hand; and
29. Assist in the training and mentoring of new diver/tenders and entry level tenders

3.6 UXO DIVER II

A. Qualifications

1. Divers shall have a thorough understanding regarding the equipment and tools to be used during the work. They shall have a sound knowledge of the operational and emergency procedures relevant to their work. Additionally, divers shall h a v e training or experience in the following areas:

   a) Air diving procedures and techniques, and, if applicable, mixed gas diving procedures and techniques;
   b) Emergency procedures;
   c) Management of diving incidents; and
   d) Proper operation and use of all equipment related to air diving, including decompression chambers.

2. All divers must meet the required standards from an ACDE accredited school, a school that instructs at ANSI standards level or is approved by the ADCI, a military school, or equivalent approved by AOR.
3. Completed a UXO technician certification' 29491 UXO-TI' course IAW DDESB TP-18

B. General Duties

1. The diver must read and comply with all AOR policies, procedures and practices as well as all regulations as they apply to divers' related qualifications or performance.
2. The diver must possess an ADCI/or local equivalent-approved current medical clearance to dive and a current logbook (ADCI Professional Diver's l o g b o o k or equivalent). This logbook is to be kept up-to-date.
3. The diver is expected to perform all diving duties appropriate to his qualifications as instructed by the diving supervisor. If the job requires work beyond the experience or capabilities of the diver, the diver shall advise the diving supervisor.
4. The diver is expected to follow safe diving practices at all times during diving operations, whether on deck or in the water. The diver must bring any points, issues, and/or concerns pertaining to the job, dive safety and/or the dive operations to the attention of the diving supervisor.

C. Responsibilities

The diver has the responsibility to:

1. Keep in good physical condition;
2. Comply with all policies, procedures and/or practices of AOR and any applicable government agency;
3. Inform the diving supervisor if he is unfit, has a condition and/or or if there is any other reason why he should not go or remain under water or in a decompression chamber. He must report any recent illness or medical treatment and advise the diving supervisor of any prescription drugs or medication he is taking so that a determination can be made to his ability to dive safely; any current/ongoing symptoms/illnesses are to be made known when diver reports to the jobsite and immediately before a dive.

4. Report any illnesses, symptoms or injury pre and post dive immediately to the diving supervisor;
5. Check all basic diving equipment that he would normally use on a dive, including any emergency equipment, ancillary equipment, or personal protective equipment (PPE). Before entering the water, and he should be satisfied that his equipment is functional and in proper working order;
6. Report to the diving supervisor any defective or malfunctioning diving equipment provided for the diving operation;
7. As required, assist in the setup, maintenance, and repair of all diving equipment on the job;
8. Comply with regulations or instructions concerning the use, repair, maintenance, and testing of all diving equipment provided for the operation;
9. Act as standby diver when required and following all requirements found in *Section 3.8;*
10. Ensure that he is fully briefed prior to a dive and fully understands the task to be carried out;
11. Report the exact condition of the work site to the diving supervisor, including any hazards that might exist for the divers who follow in rotation;
12. Make certain the deepest depth of dive has been established prior to leaving bottom;
13. Obey the diving supervisor when instructed to depart the work site for a return to the surface or the first water stop;
14. Safely exit the water and make a timely transition into the decompression chamber within the prescribed time limit, as noted in the air/gas surface diving tables;
15. Remain awake in the vicinity of the decompression chamber for a minimum of 2 hours after the completion of each dive, decompression, or treatment;
16. Ensure, on completion of a dive, that his equipment is cleaned and stowed and that any equipment faults are brought to the attention of the diving supervisor;
17. Review the dive sheet within the calendar day of the dive and ensure correctness. Any discrepancies are to be reported to the diving supervisor for appropriate action. The diver is to sign the dive sheet after review;
18. Comply with the facility safety requirements;
19. Be able to apply the routine emergency procedures that are detailed in the relevant manuals on board;
20. Immediately report any incident, injury, illness, symptom and/or feeling unwell to the diving supervisor and/or dive superintendent before dive, during dive, during surface interval and post dive;
21. Know and observe the rules for time limitations of flying after diving;
22. Not to do heavy lifting with an hour of surfacing from a decompression dive;
23. Maintain a diver's logbook that details all dives, medical examinations, courses taken, certification level achieved, and personal equipment maintenance;
24. Ensure medical certifications are up-to-date and recorded in a personal log book;
25. Present their log book to the diving supervisor on every job for his signature following a dive;
26. Maintain certification in first aid, CPR and O2 administration;
27. Have experience in the use of diving equipment;
28. Be familiar with the type of work at hand; and
29. Assist in the training and mentoring of new diver/tenders and entry level tenders

3.7 AIR DIVER

A. Qualifications

1. Divers shall have a thorough understanding regarding the equipment and tools to be used during the work. They shall have a sound knowledge of the operational and emergency procedures relevant to their work. Additionally, divers shall have training or experience in the following areas:

a) Air diving procedures and techniques, and, if applicable, mixed gas diving procedures and techniques;
b) Emergency procedures;
c) Management of diving incidents; and
d) Proper operation and use of all equipment related to air diving, including decompression chambers.

2. All divers must meet the required standards from an ACDE accredited school, a school that instructs at ANSI standards level or is approved by the ADCI, a military school, or equivalent approved by AOR.

B. General Duties

1. The diver must read and comply with all AOR policies, procedures and practices as well as all regulations as they apply to divers' related qualifications or performance.
2. The diver must possess an ADCI/or local equivalent-approved current medical clearance to dive and a current logbook (ADCI Professional Diver's logbook or equivalent). This logbook is to be kept up-to-date.
3. The diver is expected to perform all diving duties appropriate to his qualifications as instructed by the diving supervisor. If the job requires work beyond the experience or capabilities of the diver, the diver shall advise the diving supervisor.
4. The diver is expected to follow safe diving practices at all times during diving operations, whether on deck or in the water. The diver must bring any points, issues and/or concerns pertaining to the job, dive safety and/or the dive operations to the attention of the diving supervisor.

C. Responsibilities

The diver has the responsibility to:

1. Keep in good physical condition;
2. Comply with all policies, procedures and/or practices of AOR and any applicable government agency;
3. Inform the diving supervisor if he is unfit, has a condition and/or or if there is any other reason why he should not go or remain under water or in a decompression chamber. He must report any recent illness or medical treatment and advise the diving supervisor of any prescription drugs or medication he is taking so that a determination can be made to his ability to dive safely; any current/ongoing symptoms/illnesses are to be made known when diver reports to the jobsite and immediately before a dive.
4. Report any illnesses, symptoms or injury pre and post dive immediately to the diving supervisor;
5. Check all basic diving equipment that he would normally use on a dive, including any emergency equipment, ancillary equipment, or personal protective equipment (PPE). Before entering the water, and he should be satisfied that his equipment is functional and in proper working order;
6. Report to the diving supervisor any defective or malfunctioning diving equipment provided for the diving operation;
7. As required, assist in the setup, maintenance, and repair of all diving equipment on the job;
8. Comply with regulations or instructions concerning the use, repair, maintenance, and testing of all diving equipment provided for the operation;
9. Act as standby diver when required and following all requirements found in *Section 3.8;*
10. Ensure that he is fully briefed prior to a dive and fully understands the task to be carried out;
11. Report the exact condition of the work site to the diving supervisor, including any hazards

that might exist for the divers who follow in rotation;
12. Make certain the deepest depth of dive has been established prior to leaving bottom;
13. Obey the diving supervisor when instructed to depart the work site for a return to the surface or the first water stop;
14. Safely exit the water and make a timely transition into the decompression chamber within the prescribed time limit, as noted in the air/gas surface diving tables;
15. Remain awake in the vicinity of the decompression chamber for a minimum of 2 hours after the completion of each dive, decompression, or treatment;
16. Ensure, on completion of a dive, that his equipment is cleaned and stowed and that any equipment faults are brought to the attention of the diving supervisor;
17. Review the dive sheet within the calendar day of the dive and ensure correctness. Any discrepancies are to be reported to the diving supervisor for appropriate action. The diver is to sign the dive sheet after review;
18. Comply with the facility safety requirements;
19. Be able to apply the routine emergency procedures that are detailed in the relevant manuals on board;
20. Immediately report any incident, injury, illness, symptom and/or feeling unwell to the diving supervisor and/or dive superintendent before dive, during dive, during surface interval and post dive;
21. Know and observe the rules for time limitations of flying after diving;
22. Not to do heavy lifting with an hour of surfacing from a decompression dive;
23. Maintain a diver’s log book that details all dives, medical examinations, courses taken, certification level achieved, and personal equipment maintenance;
24. Ensure medical certifications are up-to-date and recorded in a personal log book;
25. Present their log book to the diving supervisor on every job for his signature following a dive;
26. Maintain certification in first aid and CPR;
27. Have experience in the use of diving equipment;
28. Be familiar with the type of work at hand; and
29. Assist in the training and mentoring of new diver/tenders and entry level tenders.

3.8 STANDBY DIVER

A. Qualifications

The standby diver is a qualified diver to act as a rescue diver in the event the diver experiences and emergency requiring in-water assistance. The standby diver shall be appointed by diving supervisor prior to the dive. The standby diver shall have a thorough understanding of the equipment and tools the diver intends to use during the work, and shall ensure his diving equipment is readily deployable.

The standby diver should be able to listen to all communications between the working diver and the diving supervisor during the diver. Additionally, the standby diver must have training or experience in the following areas:

1. Emergency procedures and diver rescue techniques;
2. Management of diving incidents; and
3. Proper operation and use of all equipment related to air diving, including decompression chambers.

B. General Duties

The standby diver reports to the diving supervisor. The standby diver must be capable and qualified to carry out the duties and responsibilities of the diver as set forth in Section 3.7.

C. Responsibilities

The standby diver has the responsibility to:

1. Ensure standby hat is properly fitted to standby umbilical and check for proper flow of breathing medium and adequate communications;
2. Monitor the dressing of the primary diver by the tender to verify the diver is properly dressed to enter the water and the diver's hat is cam locked (locked in place) properly;
3. Be adequately dressed to allow quick entry into the water and stay at depth as long as circumstances require;
4. Remain at the appointed station throughout the dive and in-water decompression;
5. Monitor the diving radio to remain abreast of events as they happen and the status of the project;
6. Present possible emergency situations to the diver and diving supervisor and suggest what actions to take in response to each possibility; and
7. Not be assigned any task or duty that might interfere with the duties as standby diver while there is a diver in the water.

3.9 TENDER

A. Qualifications

Lead tenders shall have a thorough understanding of the equipment and tools that they will use as well as a sound knowledge of the operational and emergency procedures relevant to their work. Lead tenders must have training or experience in the following areas:

1. Same qualifications as a diver, with a lower level of required experience;
2. Familiarity with air diving and, if applicable, mixed-gas diving equipment; and
3. Have training from an approved diving school/program.

B. General Duties

The lead tender reports directly to the diving supervisor and assists the divers in the general work and maintenance during diving operations.

C. Responsibilities

The lead tender has the responsibility to:

1. Run, test, and load out the equipment assigned to the job. The lead tender will ensure that all items are complete and equipment is tested as required, and will double-check the tie-downs on the work platform, barge, vessel, etc.
2. Ensure that the chamber, volume tanks, and gas cylinders used on jobs have current certification and proper paper work;
3. Ensure that any mechanical problem or equipment deficiency is immediately reported to the diving supervisor. The deficient equipment should be "red tagged" with the full explanation of the problem or immediately repaired;
   Assist the diver in dressing and undressing of diving equipment;
4. Tend the diver's umbilical (keeping at least one hand on the umbilical at all times);
5. Assist other crew members in loading out equipment on vehicles or ships;
6. Assist with deck work and tool handling;
7. Clean and maintain auxiliary tools and equipment;
8. Set up and operate all equipment, as directed;
9. Immediately report any conditions that are unsafe or potentially hazardous;

10. Properly tend the surface diver, taking in or paying out such umbilical as may be required, transmit and receive such signals as may be directed or required, and remain alert to the amount of slack paid out or for any unusual or potentially hazardous circumstances;
11. Become familiar with the line signals;
12. Properly operate a decompression chamber required for decompression or treatment, if assigned to operate a decompression chamber;
13. Notify supervisor of any changes in diver's condition, or issues with equipment;
14. Never leave his tending position until properly relieved;
15. Maintain proper ascent rate when operating winch to recover a stage;
16. Fully brief his relief if the diver is still deployed in the water or in the decompression chamber;
17. Properly complete all paperwork required; and
18. Maintain medical certification and training (i.e. first aid, CPR, and O2 administrator.)

4.0 MEDICAL REQUIREMENTS

All divers and tenders who are exposed to hyperbaric conditions shall be medically fit for diving and hold a valid diving medical clearance. The purpose of these guidelines is to outline recommendations concerning the extent and frequency of examinations, and define the medical requirements to be met by occupational divers and tenders who dive and/or exposed to hyperbaric conditions.

Medical exam protocols should align with the ADCI (Association of Diving Contractors International) Consensus Standards for Commercial Diving and Underwater Operations (6.2 Edition) standards for Medical Requirements (2.3) and Medical Standards and Recommendations (2.4). In addition, minimum requirements for diving shall meet the standards of OSHA 29 CFR Subpart T (Commercial Diving Operations) and dictated national or local laws.

4.1 GENERAL REQUIREMENTS

For persons engaged as divers, or otherwise subjected to hyperbaric conditions, the following ADCI medical examinations (or equivalent) are required:

1. An initial medical examination.
2. Periodic examinations are recommended on an annual basis.
3. A re-examination after a diving-related injury or illness as needed to determine fitness to return to diving duty.

4.2 PHYSICIAN'S WRITTEN REPORT

1. For persons engaged as divers or otherwise subjected to hyperbaric conditions, the initial exam and periodic medical re-examination include the following:

   a) Work history. The tests required in ADCI Consensus Standards as appropriate.
   b) Any tests deemed necessary to establish the presence of any of the disqualifying conditions listed in this section.
   c) Any additional tests the physician deems necessary.

2. All persons engaged as divers or otherwise subjected to hyperbaric conditions are required to get an annual exam. More frequent or extensive examination(s), including a complete medical re-examination, should be required if there have been any incidents (illness, accidents, etc.) during the course of that year that may have caused a change in the individual's medical condition.

4.3 RE-EXAMINATION AFTER INJURY OR ILLNESS

Any person engaged as a diver, or otherwise exposed to hyperbaric conditions, will have a medical examination following an injury or illness that requires hospitalization of 72 hours or more (unless national or local laws dictate otherwise) or known decompression sickness with audio-vestibular, central nervous system dysfunction, or arterial gas embolism.

The person should not be permitted to return to work as a diver, or otherwise be subjected to hyperbaric conditions, until he is released by a physician to do so. The examining physician should determine the scope of the examination in light of the nature of the injury or illness.

4.4 TEMPORARY IMPAIRMENT OR CONDITION

Divers shall not dive or be exposed to hyperbaric conditions, other than treatment procedures, for the duration of any known temporary impairment or condition if such is likely to adversely affect health or interfere with the person's ability to perform a specific diving task or safely be exposed to hyperbaric conditions. These include, but are not limited to:

1. Colds;
2. Alcoholic intoxication or its after-effects (hangover);
3. Being under the influence of drugs;
4. Pregnancy;
5. Respiratory diseases;
6. Middle ear diseases;
7. Skin infections;
8. External ear infections; and
9. Excessive fatigue or emotional distress.

It is the diver's responsibility to inform the diving supervisor of any impairment or condition. In no case shall the diver be required to dive or be exposed to hyperbaric conditions against his will, except for treatment procedures.

4.5 MEDICAL RECORDKEEPING

An accurate medical record for each person subject to the medical specifications of this section should be established and maintained. The record should include those physical examinations specified herein including the ADCI Medical History / Physical Examination Forms and the physician's written report.

The medical record shall be maintained for a minimum of five years from the date of the last hyperbaric exposure unless otherwise prescribed by law.

4.6 WITHDRAWAL FROM HYPERBARIC CONDITIONS

An individual's fitness to dive in ongoing operations will be determined by the AOR Compliance, Health & Safety Manager and Operations Managers based on the history of the case, physician's examination, and whether a person's health will be impaired by continued exposure to hyperbaric conditions. Ultimate ruling on a diver's condition to dive will be signed by the AOR Diving Operations Manager.

For additional medical examination guidance, refer to ***Appendix G – AOR Guidelines for Medical Examinations for Divers.***

5.0 OPERATIONAL PLANNING AND SAFETY

5.1 INTRODUCTION

A. AOR has developed and maintains this Safe Practices Manual for Underwater Operations for the safety and health of divers and as required by government regulations. This manual shall be made available at all dive locations for each dive team member to review.

B. AOR's safe working practices are based on operational experience and meet or exceed the requirements of OSHA, USACE, and the ADCI Consensus Standards.

5.2 PLANNING AND SAFETY CONSIDERATIONS AND PROCEDURES

A. Planning and Safety go hand in glove and both are essential to a successful operation. All personnel involved in each operation should be involved in planning and hazard identification/assessment to the maximum extent possible. Thorough planning should identify all safety issues. While no amount of planning and assessing can eliminate all risk, no diving at AOR shall be continued with unidentified risk. Changing conditions may present unforeseen circumstance not previously addressed. In this case, stop work and assess the hazards. No safety concern communicated by any team member shall be dismissed.

B. The following shall be available at the dive site to all dive team members:

1. Safe Practices Manual for Underwater Operations;
2. Dive Operations Plan
3. Activity Hazard Analysis;
4. Emergency Management Plan;

C. The following subsections list minimum guidelines for specific safety checklists and equipment confirmations. These minimum guidelines may require modification, depending on the specific diving mode or work site needs.

5.2.1 General Company Safety Procedures

For general safety procedures and safety rules, refer to *AOR Health and Safety Standards and Implementations Manual.* Diving Superintendents and diving supervisors, and project managers and coordinators are responsible for knowledge and compliance with customer and facility safety requirements in addition to AOR policy.

5.2.2 Planning and Assessment

At a minimum, Planning shall include:

A. Work tasks and schedule.
   1. Include daily and weekly schedule with dive cycle times.

B. Site assessment, including:
   1. Surface and underwater conditions;
   2. Operational and environmental Hazards;
   3. Means of water entry and normal and emergency water exit;

C. Risk assessment:

1. Hazard identification;
2. Hazard analysis;
3. Hazard mitigation

D. Personnel assessment:
   1. Dive team capability and assignments;
   2. Team certifications;

E. Dive equipment assessment:
   1. Diving mode;
   2. Breathing gas supply duration, including reserves;
   3. Dive station set-up, pre-dive checklists (equipment, helmets, chamber, etc.)
   4. Thermal protection;

F. Decompression requirements:
   1. Repetitive diving procedures;
   2. Decompression procedure:
   3. Altitude corrections;

G. Emergency procedures;
   1. Site emergencies (fire, flooding, extreme weather);
   2. Equipment/systems failure;
   3. Personnel casualty (diving and non-diving)

H. Communication Plan

5.2.3 Risk Management

A. All operations planning shall employ risk management and include a site specific Activity Hazard Analysis (AHA.) Risk management is a long term overall program that assesses risk to personnel, risk to equipment, risk to the company, and risk to the mission. AHAs are specific to a job and a site and assess and eliminate or mitigate hazards to the lowest possible level of risk.

   1. Risk assessment is a formal process for identifying hazards associated with all possible job tasks/methods that may be undertaken by AOR. It identifies potential hazards associated with job tasks and environmental conditions and identifies control measures to mitigate or eliminate hazards. Risk assessment provides the foundation for AHAs.

   2. Risk assessments shall be undertaken when:

      a) Performing any non-routine activity;
      b) Performing a new task;
      c) New personnel are involved;
      d) Third party personnel are involved; or
      e) Major changes to the job plan are considerations

5.2.4 Activity Hazard Analysis (AHA)

AHAs shall be carried out as part of planning and during shift changes. The AHA Worksheet Form shall be used and names of participants shall be listed on the form.

A. The purpose of an AHA is to identify hazards associated with each step of a job and develop solutions that will either eliminate or mitigate the hazards. The relevant job/task plan and relevant

Work Permits shall be included in the AHA. The basic steps to performing a AHA are as follows:

1. Break the job into planned steps;
2. Identify possible hazards associated with each step;
3. Develop solutions or controls to mitigate each potential hazard;
4. Identify personnel involved;
5. Revise or modify as appropriate; and
6. All affect personnel shall sign the AHA.

B. The order of precedence and effectiveness of hazard control is the following:

1. Engineering controls.
2. Administrative controls.
3. Personal protective equipment.

C. Engineering controls include the following:

1. Elimination/minimization of the hazard - Designing the facility, equipment, or process to remove the hazard, or substituting processes, equipment, materials, or other factors to lessen the hazard;
2. Enclosure of the hazard using enclosed cabs, enclosures for noisy equipment, or other means;
3. Isolation of the hazard with interlocks, machine guards, blast shields, welding curtains, or other means; and
4. Removal or redirection of the hazard.

D. Administrative controls include the following:

1. Written operating procedures, work permits, and safe work practices;
2. Exposure time limitations (used most commonly to control temperature extremes and ergonomic hazards);
3. Monitoring the use of highly hazardous materials;
4. Alarms, signs, and warnings;
5. Buddy system; and
6. Training

E. Personal Protective Equipment - such as respirators, hearing protection, protective clothing, safety glasses, and hardhats—is acceptable as a control method in the following circumstances:

1. When engineering controls are not feasible or do not totally eliminate the hazard;
2. While engineering controls are being developed;
3. When safe work practices do not provide sufficient additional protection; and
4. During emergencies when engineering controls may not be feasible.

Use of one hazard control method over another higher in the control precedence may be appropriate for providing interim protection until the hazard is abated permanently. In reality, if the hazard cannot be eliminated, the adopted control measures will likely be a combination of all three items instituted simultaneously.

5.2.5 Hazards to Diving Operations

A. Identification of hazards is the cornerstone of safe diving operations. Unidentified hazards cannot be controlled and therefore impart unmitigated risk into an operation. At a minimum, every diving operation shall be assessed for the following inherent hazards:

1. Personnel readiness;
2. Use and storage of high and low-pressure air;
3. Water entry and exit;
4. Hazards contributing to pulmonary over inflation and decompression sickness risk;
5. Site hazards;
6. Simultaneous operations which may affect diving operations

B. See **appendix A** for a comprehensive list of hazards and controls.

5.3 EMERGENCY ASSISTANCE

A. AOR maintains a list of available sources of emergency aid, equipment, and professional assistance. The emergency contact list, which includes phone numbers and contact instructions, shall be readily available at all principal places of business, operating locations, in order to fulfill the company's Emergency Management Plan.

B. The Emergency Management Plan at the jobsite shall include information necessary for the requisition of, or access to, the following types of emergency aid appropriate for the specific diving operation:

1. Location of nearest operational recompression chamber (if not on site);
2. Hospital or emergency treatment facility;
3. Hospital or emergency treatment facility with a Burn Trauma Unit;
4. Air or ground evacuation;
5. On-call physician;
6. USCG Rescue Coordination Centers; and
7. Company contacts for the Crisis Communication Plan.

F. First Aid Supplies

First aid supplies, appropriate to the type of operation being conducted, shall be readily accessible at the work site. First aid supplies should be adequately stocked sufficient for the crew size. The first aid kit shall be inspected monthly. If a recompression chamber is on the jobsite, a first aid jump kit shall be available suitable for hyperbaric use. In addition to this first aid kit, the supplies at the dive location shall include:

1. An American Red Cross standard first aid handbook (or equivalent);
2. A bag-type manual resuscitator with transparent mask and tubing;
3. A backboard suitable for patient transport;
4. An eyewash bottle or access to an eyewash station; and
5. An emergency O_2 administration kit.

G. Recompression Chamber Availability

A recompression chamber may be required on dive locations, dependent upon the hazards of the dive, OSHA and USACE regulations. On all AOR dive locations, a dual-lock recompression chamber having a minimum capacity of 6 ATA (equivalent to 165 fsw) shall be available and ready for use for:

1. Any diving in excess of 100 fsw;
2. Dives deeper than 60 fsw when live boating;
3. For any dive with planned decompression, regardless of depth;
4. For any dive requiring in-water decompression.

5. Dives to water depths which require no planned decompression should be evaluated to determine if a decompression chamber is necessary. Factors that should be taken into account when conducting the risk assessment to determine the need for a recompression chamber include:

   a) Dive site location with respect to a known location of a recompression chamber that will be available under emergency circumstances;
   b) Multi-day and/or repetitive diving operations;
   c) Potential for diver fouling or entrapment;
   d) Potential for diver blow up;
   e) Potential hazards that contribute to decompression sickness.

5.4 COMMUNICATIONS PLAN

A. A sound communications plan supports daily operations and the Emergency Management Plan. The communications plan identifies lines of communication and authority between AOR, the prime contractor, the customer, local facility, emergency resources, and local authorities in the following cases:

   1. Normal operations;
   2. Activation of the Emergency Management Plan;
   3. Contractual conflict;

B. There shall be an operating two-way audio-communications system to enable contact between the diver and the diving supervisor at all times during the dive. If communications are lost and cannot be restored in a short period of time, the dive shall be aborted.

C. Two-way communications shall be available on site and tested to ensure normal flow of communication and communication to emergency resources in the event of an emergency.

D. See *Appendix B Commercial Diving Checklists* for a sample Emergency Assistance Checklist.

6.0 OPERATION SPECIFIC REQUIREMENTS

6.1 INTRODUCTION

A. Projects involving dive operations conducted by or on behalf of AOR shall have documented operational procedures to ensure safe and effective operations. The following procedures and plans shall be prepared in compliance with the AOR EHS Management System:

   1. Onboard operational procedures describing the required operation and handling of the diving system;
   2. Operational checklists for all relevant equipment and all actions to be taken during a normal operation; and
   3. Procedures to ensure a safe and practical means of entry and egress for the primary and standby divers.

B. Specific operations procedures will vary with the type of diving mode employed. Prior to mobilization of operations, a risk assessment and/or AHA shall be performed to determine the appropriate diving mode, equipment, and job manning requirements

C. Deviation from normal operations procedures may take place only after the appropriate deviation has been approved and a Management-of-Change has been issued.

D. Equipment modification performed on any part of the diving system or associated tools used in the operations shall be accompanied by updated operational procedures, including any necessary drawings, figures, and tables.

6.2 Remotely Operated Vehicle (ROV)

ROVs are a valuable asset and their use should be considered for every operation. ROVs can be used in situations or conditions which may be otherwise harmful to humans such as contaminated water, hot or very cold water, and potential or actual differential pressure situations.

ROVs should be considered even if for only an initial assessment or to confirm bottom conditions. ROVs may also be utilized to locate objects or a work site. Once located, a diver can follow the ROV tether to the object or work site which minimizes the duration of human exposure to otherwise hazardous conditions.

No AOR employee shall operate company ROVs without proper training. ROV shall be treated with the same care and concern as diver life support equipment to ensure safety and to prevent damage to valuable equipment.

More information on the size, capability, and procedures for launch, operation, and recovery of ROVs may be found in ADCI Consensus Standard section nine.

Company ROVs shall be maintained by trained and competent personnel only in accordance with the manufactures recommendation.

6.3 SELF-CONTAINED DIVING (SCUBA)

Though SCUBA is not a standard method of diving in the commercial industry, AOR promotes the use of SCUBA where it can be shown to be more safe and efficient than the alternate modes of diving. AOR recommends that Surface-supplied equipment be used in most diving operations. As with all dives conducted by AOR, a full risk assessment of the operations shall be carried out, and approval from the Diving Operations Manager and the C/H&S Manager will be required.

A. SCUBA diving operations shall comply with applicable statutory regulations and industry standards, in particular:

1. OSHA Part 1910 – Occupational Safety and Health Standards, Subpart T, Commercial Diving Operations
2. Occupational Safety and Health Administration (OSHA) Directive Number: CPL 02-00- 051 (effective date: January 29, 2016)
3. The Association of Diving Contractors International, Inc. (ADCI) Consensus Standards for Commercial Diving and Underwater Operations Rev. 6.2, Sixth Edition, 2016
4. US Navy Diving Manual Rev. 7 SS521-AG-PRO-010 0910-LP-115-1921, December 01 2016
5. US Army Corps of Engineers Safety and Health Requirements Manual, Regulation number EM385-1-1, 30 November 2014

B. The following are minimum requirements for SCUBA diving operations:

1. The maximum planned depth and bottom time of each dive shall be determined prior to the start of operations;
2. A weight belt appropriate for the suit and depth of the dive shall be worn, except when conditions dictate otherwise for the safety of the diver;

3. When diving from a pier or in a location where the tenders cannot reach diver while he is in the water, a separate safety harness with a positive buckling device shall be worn. The harness shall distribute the load of the diver's body evenly and maintain the diver in a head ups position during lifting. When needed, a retrieving line shall be attached to the lift ring on the harness to pull the diver from the water. The harnesses should be worn under all other types of equipment;
4. Each dive team member shall be continuously monitored and, if required, tended while in the water;
5. No dives shall be conducted deeper than 100 fsw.
6. All dives will be planned for No-Decompression.
7. At a minimum, one diver or tender assigned to each crew must be competent and qualified to perform the duties of a standby diver in order to render emergency assistance to the assigned diver;
8. There shall be a plan for recovery of an unconscious or disabled diver from the water.

6.3.1 SCUBA Diving – General Requirements

A. All equipment and manning levels should be considered the recommended minimum for approaching SCUBA diving based on one dive. Increased manning levels and additional equipment may be required. Proper job planning shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations and an adequate response to emergencies.

B. At no time, shall any member of the dive team be asked to perform an activity that prevents that person from the immediate and continuous performance of the diving supervisor's assigned responsibilities.

C. At least one qualified dive team member assigned to each dive crew must be fully competent, equipped and designated to perform the duties of a standby diver in order to render emergency assistance to the assigned diver.

D. The minimum number of personnel comprising a dive team shall never be less than (4) four. Minimum personnel requirements should take into consideration not only the direct requirements of the work to be performed but also additional factors known or suspected that may lead to complications during the conduct of the intended operations.

E. Additional crew member may be required for diving operations with an increased likelihood of diver entrapment, deployment and recovery of the diver from the water, recovery of an unconscious or incapacitated diver, or working in higher risk environments.

F. All dives conducted during live boat operations shall follow the guidelines of *Section 6.5.*

G. A Full-Face Mask (FFM) may be used with an approved single hose first-stage regulator with and octopus, to the maximum approved depth of the regulator not to exceed 100 ft.

H. In open water, the diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations.

I. Divers shall terminate their dive so that they reach the surface with a minimum of 500psig or anytime that any diver is required to go on secondary/reserve air.

J. A diver-carried reserve breathing gas supply shall be provided for each diver consisting of: A manual reserve (J valve); or an independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus

K. SCUBA operations shall NOT be conducted:

1. At depths greater than 100 ft
2. Against currents exceeding one knot
3. In enclosed or physically confining spaces
4. In areas where pressure differentials exist and it cannot be positively verified that all potential leaks have been eliminated
5. Where the dive does not have direct access to the surface

The following subsections describe minimum requirements for specific SCUBA operations.

6.3.2 SCUBA Diving (0 to 100 fsw) with No Planned Decompression

A. Minimum Required Equipment. All equipment must be within certification date:

1. 2 sets of SCUBA equipment consisting of:

    a) SCUBA cylinder (should consist of a minimum of 80cuft)
    b) Regulator with octopus
    c) Buoyancy Compensation Device (BCD)
    d) Pressure gauge
    e) Harness as required in *Section 6.3.B.3*
    f) Reserved gas supply: J valve or secondary cylinder with regulator.
    g) FFM (as required)
    h) Thru water comms (as required)

2. 1 set of air decompression and treatment tables;
3. 1 Safe Practices Manual for Underwater Operations;
4. 1 diving ladder or other safe means of getting a diver out of the water;
5. 2 tending lines
6. 1 buddy line
7. 1 retraction line for emergency extraction of diver, as required in *Section 6.3.B.3*
8. 1 set first aid supplies;
9. 1 emergency O_2 administration kit;
10. 2 timekeeping devices;

11. 2 sets of diver's personal diving equipment consisting of;

    a) mask
    b) weights as required
    c) protective clothing
    d) tools, as required
    e) safety harness
    f) fins
    g) knife
    h) watch with timing device or dive computer
    i) depth gauge or dive computer

12. Log book and dive sheets.

B. Minimum Required Personnel (4)

1. 1 Dive Supervisor
2. 1 Diver
3. 1 Standby Diver (qualified to dive and capable of performing the duties of standby diver)
4. 1 Tender

C. Minimum Qualifications of Personnel

Personnel qualifications are described in *Section 3.0.*

6.4 SURFACE-SUPPLIED DIVING

A. Surface-supplied diving operations shall comply with applicable statutory regulations and industry standards, in particular:

1. OSHA Part 1910 – Occupational Safety and Health Standards, Subpart T, Commercial Diving Operations
2. Occupational Safety and Health Administration (OSHA) Directive Number: CPL 02-00- 051 (effective date: January 29, 2016)
3. The Association of Diving Contractors International, Inc. (ADCI) Consensus Standards for Commercial Diving and Underwater Operations Rev. 6.2, Sixth Edition, 2016
4. US Navy Diving Manual Rev. 7 SS521-AG-PRO-010 0910-LP-115-1921, December 01, 2016
5. US Army Corps of Engineers Safety and Health Requirements Manual, Regulation number EM385-1-1, 30 November 2014

B. The following are minimum requirements for surface-supplied diving operations:

1. The maximum planned depth and bottom time of each dive shall be determined prior to the start of operations;
2. A weight belt appropriate for the suit and depth of the dive shall be worn, except when conditions dictate otherwise for the safety of the diver;
3. A separate safety harness with a positive buckling device shall be worn. The harness shall distribute the load of the diver's body and prevent any strain from being placed on the diver's mask or helmet when the umbilical attached to the lift ring on the harness is pulled. Except for heavy gear diving, harnesses should be worn under all other types of equipment;
4. Each dive team member shall be continuously tended while in the water;
5. For dives, deeper than 100 fsw, a separate dive team member shall tend each diver in the water;
6. At a minimum, one diver or tender assigned to each crew must be competent and qualified to perform the duties of a standby diver in order to render emergency assistance to the assigned diver;
7. Each diving operation shall have a primary and secondary breathing gas supply sufficient to support the diver for the duration of the planned dive, one emergency dive by the standby diver, including decompression;
8. When diving through an air gap that exceeds 15 feet, a stage and a man-rated lifting system shall be used to accommodate the primary diver and standby diver;
9. There shall be a plan for recovery of an unconscious or disabled diver from the water; and
10. A diver-carried reserve breathing supply (bailout bottle) shall be worn on all dives, regardless of depth, and provide a physiologically appropriate mixture (bottom mix) for the depths involved. In all cases, the reserve breathing supply also shall be of sufficient duration, to allow the diver to reach the surface or another source of breathing supply (stage, open bell, etc.) or be reached by the standby diver, who is equipped with another

source of breathing supply.

a) For surface diving operations, the diver-carried reserve breathing supply shall have a minimum capacity of 30 cu. ft. that is maintained at a pressure to enable a minimum of five (5) minutes supply at the anticipated depth.
b) Use of a bailout bottle smaller than 30 cu. ft. on any dive job shall require approval by the Manager of Diving Operations.
c) In all cases, activation of the diver's reserve shall cause the dive to be aborted. The reason for activation of the reserve must be ascertained and corrected prior to continuation of diving activities.
d) Bail-out bottles filled with any mixture other than air, shall be analyzed and that analysis shall be clearly marked and initialed on the cylinder.

6.4.1 Surface-Supplied Air Diving – General Requirements

A. All equipment and manning levels should be considered the recommended minimum for approaching surface-supplied air diving based on one dive and any applicable decompression required. Increased manning levels and additional equipment may be required. Proper job planning shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations and an adequate response to emergencies.

B. At no time, shall any member of the dive team be asked to perform an activity that prevents that person from the immediate and continuous performance of the diving supervisor's assigned responsibilities.

C. At least one qualified dive team member assigned to each dive crew must be fully competent, equipped and designated to perform the duties of a standby diver in order to render emergency assistance to the assigned diver.

D. The minimum number of personnel comprising a dive team shall never be less than (4) four. Minimum personnel requirements should take into consideration not only the direct requirements of the work to be performed but also additional factors known or suspected that may lead to complications during the conduct of the intended operations.

E. Additional crew member may be required for diving operations with an increased likelihood of diver entrapment, deployment and recovery of the diver from the water, recovery of an unconscious or incapacitated diver, or working in higher risk environments.

The following subsections describe minimum requirements for specific surface-supplied air diving operations.

6.4.2 Shallow Air (0 to 100 fsw) with No Planned Decompression

A. Minimum Required Equipment. All equipment must be within certification date.

1. 1 air sources with 1 volume tank to support two divers;
2. 1 onsite secondary (emergency) air source;
3. 2 diving hose groups, each consisting of;
    a) air hose
    b) strength member (the strength member may be the entire hose assembly, if so designed)
    c) communications cable
    d) pneumofathometer hose

4. 1 set of air decompression and treatment tables;
5. 1 Safe Practices Manual for Underwater Operations;
6. 1 control station consisting of;
   a) communications system
   b) depth gauges and gas distribution system with the capability to supply and control two divers at the maximum planned depth
7. 1 diving ladder or other safe means of getting a diver out of the water;
8. 1 set first aid supplies;
9. 1 emergency O_2 administration kit;
10. 2 timekeeping devices;
11. 2 sets of diver's personal diving equipment consisting of;
    j) helmet or band mask
    k) weights as required
    l) protective clothing
    m) tools, as required
    n) safety harness
    o) bail-out bottle (diver worn EGS)
    p) knife?

12. Log book and dive sheets.

B. Minimum Required Personnel 4)

1. 1 Diving Supervisor
2. 1 Diver
3. 1 Stand-by Diver
4. 1 Tender (qualified to dive and capable of performing the duties of standby diver)

C. Minimum Qualifications of Personnel

Personnel qualifications are described in *Section 3.0.*

6.4.3 Deep Air (0 to 100 fsw) with Planned Decompression

A. Minimum Required Equipment

1. 2 independent air sources with 2 independent volume tanks to support 2 divers and decompression chamber;
2. 1 onsite secondary (emergency) air source;
3. 1 double-lock decompression chamber which has adequate air supply to recompress the chamber to 165 fsw;
4. Adequate supply of gases for the planned dive profiles, one emergency dive, and a potential treatment (using Treatment Table 6A);
5. 1 stage or work platform for any planned in-water decompression greater than 30 minutes;
6. 2 diving hose groups, each consisting of;
   a) air hose
   b) strength member (the strength member may be the entire hose assembly, if so designed)
   c) communications cable
   d) pneumofathometer hose
7. 1 set of air decompression and treatment tables;
8. 1 Safe Practices Manual for Underwater Operations;
9. 1 control station consisting of;
   a) communications system;

   b) depth gauges and gas distribution system with the capability to supply and control two divers at the maximum planned depth
10. 1 diving ladder or other safe means of getting a diver out of the water;
11. 1 set first aid supplies;
12. 1 emergency O_2 administration kit;
13. 2 timekeeping devices;
14. 2 sets of diver's personal diving equipment consisting of;
   a) helmet or band mask
   b) weight belt, if appropriate
   c) protective clothing
   d) tools, as required
   e) safety harness
   f) bail-out bottle (diver worn EGS)
   g) knife (to be carried only by the diver and standby diver while working underwater)
15. Log book and dive sheets;
16. Neurological Exam Check sheets and DCI Treatment sheets.

B. Minimum Required Personnel (5)

1. 1 Diving Supervisor
2. 1 Diver
3. 1 Standby Diver
4. 2 Tenders

C. Minimum Qualifications of Personnel

Personnel qualifications are described in *Section 3.0.*

6.4.4 Deep Air (101 fsw to 190 fsw) with Planned Decompression

A. Minimum Required Equipment

1. 2 independent air sources with 2 independent volume tanks to support 2 divers and decompression chamber;
2. 1 onsite secondary (emergency) air source;
3. 1 double-lock decompression chamber which has adequate air supply to recompress the chamber to 165 fsw;
4. Adequate supply of gases for the planned dive profiles, one emergency dive, and a potential treatment (using Treatment Table 6A);
5. 1 stage or work platform for planned in-water decompression greater than 30 minutes;
6. 2 diving hose groups, each consisting of;
   a) air hose
   b) strength member (the strength member may be the entire hose assembly, if so designed)
   c) communications cable
   d) pneumofathometer hose
7. 1 set of air decompression and treatment tables;
8. 1 Safe Practices Manual for Underwater Operations;
9. 1 control station consisting of;
   a) communications system
   b) depth gauges and gas distribution system with the capability to supply and control two divers at the maximum planned depth
10. 1 diving ladder or other safe means of getting a diver out of the water;
11. 1 set first aid supplies;
12. 1 emergency O_2 administration kit;

13. 2 timekeeping devices;
14. 2 sets of diver's personal diving equipment consisting of;
    a) helmet or bank mask
    b) weight belt, if appropriate
    c) protective clothing
    d) tools, as required
    e) safety harness
    f) bail-out bottle (diver worn EGS)
    g) knife (to be carried only by the diver and standby diver while working underwater)
15. Log book and dive sheets;
16. Neurological Exam Check sheets and DCI Treatment sheets.

B. Minimum Required Personnel (5)

1. 1 Diving Supervisor (not in dive rotation)
2. 1 Diver
3. 1 Standby Diver
4. 2 Tenders

C. Minimum Qualifications of Personnel

Personnel qualifications are described in *Section 3.0.*

6.5 Live boating – General Requirements

Live boating is defined as diving during vessel movement (under power or drifting) in support of diving operations. This method of diving is preferred in instances where anchoring is difficult, under conditions with high currents, when the dive plan makes it likely that divers will move away from the initial dive location, and in locations where divers may need to be shielded from other vessel traffic.

A. Depth Limits: The maximum depth for live boating operations is 165 fsw.

B. In all cases, personnel manning equipment shall be selected to ensure maximum safety during operation. Depending on the water depth, the minimum manning requirements for the dive team shall be five (5) persons. On small boats/vessels of less than 33 feet in length, and while diving to limited water depths, it may be permissible for the dive team to consist of three (3) persons (diving supervisor, diver, standby diver, and a tender) due to space limitations on deck.

C. No live boating will be conducted without a job procedure, dive plan and risk assessment approved by the AOR Diving Operations Manager.

D. There will be constant and easily understandable verbal communications available between the dive station and wheelhouse (bridge) at all times.

E. The vessel will be maneuvered in such a manner so as to permit the tender or diving supervisor to continuously monitor the direction of the diver's umbilical with respect to the diving control station and the position of the vessel.

F. The propellers of the vessel are to be stopped before the diver enters or exits the water.

G. A means will be used to prevent the diver's hose from becoming entangled in the propellers of the vessel.

H. Live boating shall not be done:

1. In seas that impede the station-keeping ability of the vessel;
2. In non-daylight hours;
3. During other periods of restricted visibility; and
4. Any time existing conditions make live boating unsafe in the opinion of the boat captain or diving supervisor.

I. The Standby Diver shall be dressed in and be continuously prepared to enter the water when directed by the diving supervisor.

J. All live boating operations shall be tended from the bow and the vessel shall be operated from the wheelhouse or flying bridge.

K. A "kill switch" shall be in the immediate vicinity of the operator of the vessel for instantaneous shutdown of the engines.

6.5.1 Air Diving While Live boating – Air Diving (0 to 60 fsw)

A. Minimum Required Equipment

In addition to Minimum Required Equipment for the planned diving depth and diving mode, the following is also required:

1. On all live boating operations, a third diving hose connected to the manifold shall be available for emergency use, except in the case of small boats or vessels where sufficient space for a third diving hose and associated equipment may not be available.
2. A free-floating decompression buoy or equivalent may be used in liveboating operations whenever in-water decompression may become necessary.

B. Minimum Required Personnel (5)

1. 1 Diving Supervisor (not in dive rotation)
2. 1 Diver
3. 1 Standby Diver
4. 2 Tenders

C. Minimum Qualifications of Personnel

In addition to minimum personnel qualifications described in *Section 3.0,* personnel working on live boating operations, including the vessel captain/master shall be sufficiently experienced in such operations for the dive being conducted.

6.5.2 Live boating – Air Diving (61 to 165 fsw)

A. Minimum Required Equipment

In addition to Minimum Required Equipment in *Section 6.3.1* for the planned diving depth and diving mode, the following is also required:

1. On all liveboating operations, a third diving hose connected to the manifold shall be available for emergency use except in the case of small boats or vessels where sufficient space for a third diving hose and associated equipment may not be available.
2. A free-floating decompression buoy or equivalent may be used in liveboating operations whenever in water decompression may become necessary.

B. Minimum Required Personnel (6)

1. 1 Diving Supervisor (not in dive rotation)
2. 1 Diver
3. 1 Standby Diver
4. 3 Tenders

C. Minimum Qualifications of Personnel

In addition to minimum personnel qualifications described in *Section 3.0,* personnel working on liveboating operations, including the vessel captain/master, shall be sufficiently experienced in liveboating operations for the dive being conducted.

6.6 Diving at Altitude

Divers may be required to dive in bodies of water at high altitudes. Planning shall address the effects of atmospheric pressures that may be much lower than those at sea level. Transporting divers out of the diving area, which may include movement into even higher elevations, either overland or by plane, requires special consideration and planning.

When a dive takes place at altitude higher than 1,000 feet above sea level, it is necessary to make appropriate corrections in the decompression tables. In order to determine an equivalent depth in fresh water at a mountainous location, calculations need to be performed and applied to the sea level/saltwater dive table information. Depths and rate of ascent are affected and should be modified to ensure that the diver is protected against decompression illness.

Appendix E: Dive and Treatment Tables contains altitude dive worksheets.

For specific procedures and guidelines, refer to the *U.S. Navy Diving Manual (Revision 7), Section 9-13, Diving at Altitude.*

6.7 Rigging Work

Subsea activities may include both underwater and surface-mounted rigging and lifting gear for launching and retrieval of tools and equipment.

A. Deck-mounted lifting gear shall comply with relevant safe practices.

B. Rigging and lifting gear used on the subsea work site shall be certified in accordance with a recognized standard and used in accordance with recognized practices.

C. During complex lift operations involving special subsea rigging gear, multiple crane lifts, or any lift over 75% of the crane's maximum lifting capacity, a Critical lift plan shall be prepared and require management approval.

D. The diving supervisor shall maintain a system for briefing ongoing shifts (both topside personnel and the divers) concerning the actual rigging situation on the subsea work site. During such briefings, emphasis shall be given to systems under tension, and the following procedures will be discussed:

1. Establish the weight and size of the load;
2. Ensure that lifting equipment and all straps, shackles, and associated hardware are tested and approved for the load to be handled;
3. During handling, keep diver(s) and diving bell at safe distance from the load;

4. Never handle a dangerous load over a diver;
5. Ensure clear communication between the crane/winch operator and diving supervisor, and
6. The crane/winch operator shall never move a load unless clearly instructed by the diving supervisor, or his designee.

6.8 Electrical Hazards

Working activities can include electrical tools, specifically designed for underwater use, such as:

A. Electrical pumps, NDT inspection equipment, and cathodic protection measuring equipment shall comply with manufacturer's specifications for use, GFCI requirements, and any relevant regulations.

B. Remotely operated vehicles (ROVs) used in combination with divers shall comply with the *ADCI Consensus Standards for Commercial Diving Operations – 6.2 Edition.*

6.9 Hand-Held Power Tools

Power tools such as hydraulic and pneumatic drills, chainsaws, grinders, and bolt/nut tensioners are often used in subsea work activities. Consideration should be given to using:

A. Tools to be used on sensitive breakable items, as well as nuts/bolts to be set with a required torque, shall be deployed in such a manner that damage to the actual items is avoided. This situation may be achieved by introducing power limitations or other means to prevent excessive forces being applied by the tools in question.

B. Tools that can cause bodily harm to divers during use shall be fitted with the appropriate and manufacturer's recommended safety guards around potentially dangerous parts.

6.10 Welding and Burning (Oxy-Arc Cutting)

Underwater burning processes involve several potential hazards, including electrical currents and gases which may explode in the presence of spark. These processes include:

1. Oxy-Arc burning using exothermic electrodes;
2. Oxy-Arc burning using tubular steel electrodes; and
3. Shielded metal arc burning and cutting (welding rods).

Some underwater cutting processes can produce sparks (grinding) and should follow these same guidelines. Personnel required to perform underwater burning and cutting shall be familiar and equipped to perform routine underwater cutting and burning.

Actual procedures for underwater burning and cutting should be carried out in conformance with the *U.S. Navy Underwater Cutting & Welding Manual, NAVSHIPS S0300- BB-MAN-010 (1 June 2002).*

6.11 High Pressure Water Blasting

High-pressure water jets are used to clear hard and soft marine growth from structures and equipment, to clean surfaces prior to repair or inspection, and, in combination with grit, to cut or remove concrete and other material. These units typically operate at pressures of 1,000 to 40,000 psi.

Water blasters can cause serious injuries. Recommended practices and procedures do not replace the proper training necessary to operate high-pressure water blasting equipment. For underwater use, refer to *ADCI Consensus Standards (6.2 Edition), Section 5.35, High-Pressure Water Blasting.*

6.12 Explosives

Explosives are used underwater for a variety of purposes, including Unexploded Ordnance (UXO) disposal, rock clearance, cutting, deepening or widening channels, clearing local rock or debris, pile cutting, removing abandoned oil/gas well heads, pipe cutting or demolition of mass concrete, and demolition prior to salvage of wrecks or structures, or other

A. Prior to the use of explosives, a risk assessment and/or AHA shall be performed and approved by the Diving Operations Manager and the Compliance/Health and Safety Manager.

B. Procedures for the deployment of explosives shall be established in compliance with 29 CFR 1910.109, 29 CFR 1926.912, and other applicable regulations (e.g., state and local) and will include:

    1. Transport to load-out site (i.e., single component explosives shall be transported and stored in magazine boxes, and blasting caps will not be stored with explosives);
    2. Procedures for handling on the jobsite;
    3. Personnel qualifications and previous experience;
    4. Electrical continuity of explosive circuits shall not be tested with divers in the water;
    5. Line of communication between personnel involved;
    6. Blasting cap shall not be tied in until divers are safely out of the water;
    7. Dive Supervisor shall maintain custody of firing device until all personnel are in the safety location;
    8. Actions in case of misfire and/or other incidents; and
    9. Return/disposal of remaining equipment/explosives after terminating work.
    10. Detonators shall not be stored in the same magazine in which other explosives.

C. A checklist shall be prepared, followed, and signed off by the diving supervisor and project manager prior to detonation of explosives.

D. It is unlawful for any person to use, possess and control, manufacture, purchase store, transport or dispose of any explosive material without possessing a valid license issued by the proper controlling authority.

E. Unexploded Ordnance, (or UXO), are explosive weapons (bombs, bullets, shells, grenades, land mines, etc.) that did not explode when they were employed and still pose a threat of detonation, potentially many decades after they were used or discarded. If they are encountered, they should not be disturbed by untrained personnel and appropriate authorities should be notified. The location of the UXO should be recorded.

6.13 Contaminated Water Diving Operations

Diving in contaminated water increases the risk and complexity of an operation. Prior to diving in any known contaminated water, planning shall thoroughly address all aspects of the operation to protect personnel from adverse acute and chronic health effects. If while diving, a previously unknown contaminated water condition arises, diving shall be suspended until the issue is addressed appropriately in accordance with this manual. The diving supervisor shall take all precautions and mitigations available to safely recover the diver while protecting the topside crew from the suspected contaminants.

See *Appendix F: Contaminated Water Diving Operations* for further information.

6.14 Penetration Diving and Limited Access Situations

A diver entering a confining structure, other than a habitat, that is both a physically confining space and one in which there is no direct access to the surface for recovery of the diver from the water by the tender. Penetrations may include:

1. Pipelines, outfalls, tunnels, tanks, etc.
2. Entry into hatchways on sunken vessels, barges;
3. Limit access tasks under bridges, piers, pile caps, etc.

Generally, working under a vessel of barge would not be considered a penetration dive, as the diver can usually be easily pulled to the surface at the location of the topside tender. There is a clear and distinct difference between working beneath a vessel or barge, and working inside a tunnel or pipeline. In the former case, the diver may be directly retrieved by the surface tender without danger of entrapment or entanglement as the umbilical is generally maintained in a horizontal direct line to the diver. In the case of a diver entering an underwater pipeline, the umbilical will often turn a corner at the entrance to the pipeline, or even within the pipeline, and therefore must be tended at such points by another diver acting as in-water tender.

When performing any penetration requiring an in-water tender, the length of the in-water tender's umbilical should be a minimum of 10 feet longer than the diver making the penetration.

6.15 Current and Tidal Considerations and Limitations

Currents and tides produce forces that affect the diver, his umbilical, and various lines and pieces of equipment at the work site. Effects of currents on divers vary with the individual, the work being done, and the diving method being used, so it is not possible to define fixed limits. Special consideration shall be given to the following:

1. Length and buoyancy of umbilical;
2. Method of deployment;
3. Type of task being performed;
4. Diver orientation during task; and
5. Work site conditions (e.g., location, type of seabed, etc.)

6.16 Diver Entering and Leaving the Water

A. Entering and leaving the water shall be conducted in a controlled manner. There shall be a safe means for entering and leaving the water from the diving platform, such as a ladder, stage, or other appropriate device. This device shall extend a minimum of 3 feet below the water's surface. Additionally, the means of entering and leaving the water shall be adequate to facilitate rescue of personnel.

B. Ladders shall extend at least 3 feet below the water and have sufficient hand-holds above water to allow the diver to step easily onto the deck.

C. When deploying a diver through an air gap that exceeds 15 feet, a stage and a man- rated lifting system shall be used to accommodate the primary diver and standby diver.

7.0 EQUIPMENT AND SYSTEMS

7.1 GENERAL REQUIREMENTS

A wide range and variety of equipment may be required to support commercial diving and underwater operations. Equipment utilized shall be that necessary to assure the safe conduct of operations under the conditions in which it will be employed. The equipment described in this chapter shall meet the requirements as contained in the:

1. OSHA Part 1910 – Occupational Safety and Health Standards, Subpart T, Commercial Diving Operations
2. Occupational Safety and Health Administration (OSHA) Directive Number: CPL 02-00- 051 (effective date: January 29, 2016)
3. The Association of Diving Contractors International, Inc. (ADCI) Consensus Standards for Commercial Diving and Underwater Operations Rev. 6.2, Sixth Edition, 2016
4. US Navy Diving Manual Rev. 7 SS521-AG-PRO-010 0910-LP-115-1921, December 01 2016
5. US Army Corps of Engineers Safety and Health Requirements Manual, Regulation number EM385-1-1, 30 November 2014

These documents set forth the minimum jurisdictional requirements for equipment and operations.

Due to the life support nature of diving, personnel involved in the operation, maintenance, and repair of diving systems and equipment shall have appropriate training and experience in the type of equipment and how it is used. Equipment such as helmets, masks, bail-out bottles and emergency gas systems, regulators, etc. that provides direct life support shall be of the type familiar to the diver and subject to a planned maintenance system.

The diving supervisor shall ensure that all diving systems and equipment have been examined and tested to the extent necessary to determine their condition and suitability for service. Diving operations shall not be permitted to commence until all systems and equipment have been tested for proper functionality. Equipment designated as "necessary" must be able to continue operating in the event of loss of primary power through the use of batteries, stored energy (hydraulic or air power), or connection to an emergency generator.

7.2 MAINTENANCE RECORDS

A. Suitable equipment logs shall be established and maintained;
B. All equipment shall have a unique identity traceable to the equipment log;
C. Entries made in the equipment log shall describe the nature of the work performed, including the dates of modification, repair, or testing, the name of the individual performing the work or test, and the particular piece of equipment involved;
D. Individual persons performing maintenance, repair, calibration, testing, or modification to any diving equipment shall print and sign their name in the equipment log; and
E. Each diving helmet and mask will follow criteria established in *Section 7.3.7.*

7.3 DIVER'S DRESS

7.3.1 General

Diver's dress shall be suitable for the job intended, with consideration given to environmental exposure.

7.3.2 Dry Suits

Dry suits shall:

1. Have a device to prevent over-inflation (except in cases of diving in contaminated environments);
2. Be constructed of material suitable to the environment in which it is to be used;
3. Protect the diver from the environmental effects of temperature and hazardous material;
4. Not be used without pre-dive inspection.

7.3.3 Hot Water Suits

Hot water suits shall:

1. Provide a sufficient flow of water to maintain the desired temperature;
2. Be capable of withstanding an operating temperature of 110° F (44° C.); and
3. Allow the diver to bypass incoming water prior to it entering the suit.

7.3.4 Harnesses

Harnesses shall:

1. Be made of material strong enough to lift the diver and his equipment from the water; with an overall breaking strength of no less than 2,000 pounds;
2. Have a mechanical quick-release between the harness and the umbilical;
3. Be constructed and fitted to prevent an unconscious diver from slipping through; and is fitted with at least one recovery ring suitable for diver recovery from the water in an emergency;
4. Be designed to prevent restriction of the diver's breathing when his full weight is supported by the harness; and
5. Be equipped with adjustable leg straps.

7.3.5 Weight Belts

Weight belts shall:

1. Be of sufficient weight to keep the diver at working depth;
2. Not be used as an attachment for the diving umbilical;
3. Be equipped with an approved release buckle; and
4. Be attached to the diver so as to avoid accidental release.

7.3.6 Bail-out Bottle and EGS (diver-carried emergency air/gas cylinder)

Bail-out Bottle and Emergency Gas System shall:

1. Have a cylinder meeting the requirements of *Section 7.10.3*;
2. Have a regulator on the cylinder capable of delivering the proper pressure and flow to the diver's helmet or mask in accordance with the flow characteristics recommended by the helmet or mask manufacturer;
3. Have a means of attachment to the harness to prevent accidental disengagement;
4. Have a bail-out connection must meet the AOR-approved standard fitting configuration;
5. Be visually inspected annually by a AOR manufacturer-approved person or vendor;
6. Be hydrostatically tested before the required inspection expiration date every 5 years by a AOR manufacturer-approved vendor; and
7. Be clearly marked for contents and pressure.

7.3.7 Helmets

A. Dive helmets and their associated diver-carried regulators are components of a critical life support system that, if not functioning properly, can expose the diver to significant hazards. As such, all helmets and their associated diver-carried regulators shall be maintained and inspected in strict compliance with AOR and manufacturer recommendations. Logs shall be maintained.

B. It is the responsibility of the user of the helmets and associated diver-carried equipment (i.e., the diver) to ensure that these life support critical elements are functioning properly prior to the start of each and every dive; this should be logged on the pre-dive inspection.

C. Helmets used for surface-supplied diving operations shall:

1. Be of a type approved by the AOR Diving Operations Manager. Band masks shall not be used on hand jetting diving jobs. The use of a band mask must be approved by the Diving Operations Manager.
2. Be capable of ventilating up to at least 4.5 actual cubic feet per minute (ACFM) of gas when supplied at the manufacturer-recommended pressure;
3. Be capable of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute;
4. Be fitted with a two-way audio communications system;
5. Be equipped with a non-return valve in the main gas supply that closes readily and positively;
6. Have non-return valves with springs not exceeding 3 psi cracking pressure;
7. Be made of corrosion-resistant materials;
8. Be protected from over-pressurization;
9. Be maintained in accordance with manufacturer specifications;
10. Be annually inspected by a AOR approved person or vendor; and

7.3.7.1 Lightweight Diving Helmets

Lightweight diving helmets shall:

1. Meet requirements of Section 7.3.8.
2. Be fitted to accept a bail-out bottle supply; and
3. Be fitted to allow for positive and ready removal from the diver in all uses.

7.3.7.2 Specialized Application Helmets

Helmets and masks used for specialized applications shall:

1. Meet the requirements of Section 7.3.8;
2. Be inspected for deterioration prior to and after extended use in applications where elements of destructive and varied environments are known to exist (i.e., contaminated water, underwater burning, or welding); and
3. Be equipped to prevent entry of contaminants to the diver.

7.3.8 Built-in Breathing Systems (BIBS)

Built-in Breathing Systems (BIBS) utilized in recompression chambers and other types of pressure vessels for human occupancy (PVHOs) shall:

1. Be suitable for purpose and cleaned for use with oxygen;
2. Be held in place by adjustable straps, hood, or other suitable means that frees the diver's hands;
3. Be capable of providing 2.0 ACFM at maximum depth;
4. Be equipped to allow the user to adjust for ease of breathing or constant free flow;
5. Be equipped with an exhaust valve;
6. Be equipped to prevent over-pressurization or rapid negative pressure from endangering the user;
7. Be maintained in accordance with manufacturer specifications; and
8. Be disinfected prior to each use.

7.4 HOSES

7.4.1 General

Flexible hoses used with diving systems or equipment shall:

1. Have a minimum burst pressure equal to four times the maximum allowable working pressure (MAWP);
2. Have an MAWP and flow rating not less than the system in which it is installed or used, and be suitable for the use intended;
3. Have connectors with pressure capability equal to or greater than the hoses on which they are installed;
4. Have fittings of corrosion-resistant material that cannot be accidentally disengaged;
5. Be kink-resistant or arranged to prevent kinking;
6. Have suitable temperature rating when used for hot water service;
7. Be subjected to annual visual examination and tested to 1.5 times the design working pressure for 10 minutes, without loss of pressure, when corrected for temperature; and
8. Be visually examined and pressure tested after each repair or alteration.

7.4.2 Breathing Gas Hoses

Breathing gas hose assemblies shall:

1. Met the general requirements for hoses (Section 7.4.1);
2. Be suitable for breathing gas service;
3. Have an MAWP equal to or greater than maximum depth of dive relative to the supply source, plus 150 psig;
4. Be subjected to an annual hydrostatic test to 1.5 times the design working pressure with a 200-lb axial load applied on fittings while test pressure is applied for 10 minutes, without loss of pressure, when corrected for temperature or creep of end fittings; and
5. Be of suitable design to prevent collapse when used for operation with higher external pressure than internal pressure.

7.4.3 Umbilical

Diver umbilical and dive hose assemblies shall:

1. Meet the general requirements for hoses *Section 7.4.1;*
2. Be marked from the diver/bell end in 10-ft intervals up to 100 feet and marked in 50-ft intervals thereafter as shown in Table 7.1. Markings must be marked with a unique identity and be subjected to a planned maintenance program;
3. Consist of a breathing gas hose, communications cable, a means of determining the diver's depth, and include a strength member or other, such as video or hot water;

4. Have a strength member made of material unaffected by prolonged immersion in water; and
5. Have minimum break strength of the hose assembly, including terminating hardware of 1,000 lbs.

Table 7.1 Dive hose/umbilical banding color code.

Depth (feet)	Depth (meters)	Marking
10	3.05	One white band
20	6.10	Two white bands
30	9.15	Three white bands
40	12.20	Four white bands
50	15.25	One yellow bands
60	18.29	One yellow/one white band
70	21.34	One yellow/two white bands
80	24.39	One yellow/three white bands
90	27.44	One yellow/four white bands
100	30.49	One red band
150	45.73	One red/one yellow band
200	60.98	Two red bands
250	76.22	Two red/one yellow band
300	91.46	Three red bands

7.4.4 Oxygen Hoses

A. Oxygen hoses shall:

1. Meet the general requirements for hoses *(Section 7.4.1);* and
2. Meet the requirements for breathing gas hoses *Section 7.4.2.*

B. In addition, if used for oxygen service:

1. Hose assemblies used in systems containing greater than 40% oxygen are to be cleaned for oxygen service;
2. Hoses used for oxygen service shall be identified by a consistent color code or tagged “FOR OXYGEN USE ONLY”; and
3. Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.

7.5 COMPRESSOR SYSTEMS

7.5.1 Compressor and Gas Pumps

Compressors, boosters, gas transfer pumps, and filters used to provide breathing air/gas for diving shall:

1. Have suitable personnel protection around rotating machinery that meets OSHA standard for rotating machinery (29 CFR 1910.219), as well as applicable jurisdictional requirements;
2. Have the necessary instruments to facilitate operations;
3. Be of the proper type, pressure, and flow rate, and suitable for the service intended;
4. Have air intake arranged to be clear of exhaust fumes and other contaminants;
5. Have piping in accordance with ANSI Code B31.1;
6. Have flexible hoses in accordance with *Section 7.4.1;*

7. Have electrical controls, wiring, and drive units meeting jurisdictional requirements, when so equipped;
8. Not be used to pump or transfer oxygen, unless designed for oxygen service;
9. Be cleaned for oxygen service when used with mixtures of greater than 40% oxygen and equipped with slow opening valves;

7.5.2 Recording of Maintenance and Repairs

1. Entries shall be made in the equipment log for all maintenance and repairs performed on the compressor and gas system.
2. Results of air quality tests shall be kept in the equipment maintenance log.
3. Compressors shall have a unique identity incorporating manufacturer, model, serial number, and maximum-rated outlet pressure, rated capacity, and safety valve settings.
4. Compressor units shall be subject to planned maintenance.

7.5.3 Volume Tanks

Volume tanks or receivers used on compressor or breathing gas systems shall comply with *Section 7.10.1.*

7.5.4 Filtration

Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed.

7.5.5 Testing

Compressors used for breathing gas shall be functionally tested per the following schedule and conform to design specifications and air purity requirements described in *Section 7.5.6;*

1. Prior to being put into service;
2. Periodically, in accordance with manufacturer recommendations and planned maintenance schedule;
3. During annual inspection; and
4. After any repairs that may affect compressor performance.

7.5.6 Air Purity Requirements

A. Compressors, transfer pumps or booster pumps used for breathing-air service will be subjected to an air quality test annually. Compressors with a discharge pressure of 500 psig or less shall meet the standards of ANSI CGA 7.1-1989 for Grade D air as a minimum, and shall contain a maximum of 25 ppm of total hydrocarbon content (as methane). Compressors with a discharge pressure that exceeds 500 psig shall meet the requirements of ANSI CGA 7.1-1989 for Grade E air.

B. Tests in accordance with Compressed Gas Association (CGA) shall be taken at the discharge point that would normally supply the breathing gas system, the diver's hose, or cylinder fill point.

C. Compressors, transfer pumps or booster pumps used for breathing-air service will be subjected to an air quality test following any repair or modification which may affect air quality. Air quality test shall also follow any report or incident when air quality is in doubt which cannot with certainty be attributed to another cause.

D. Documentation of these tests shall be kept on file for a minimum of 3 years.

E. Compressors used for breathing-gas transfer other than atmospheric air shall be checked annually to ensure they do not introduce contaminants into the gas being processed.

7.6 DIVE ENTRY AND EGRESS SYSTEMS

All water entries shall be controlled entries. NO JUMPING IS PERMITTED.

7.6.1 Diving Ladders

Diving ladders shall:

1. Be capable of supporting the weight of two divers plus their gear;
2. Be made of corrosion-resistant material;
3. Be suitable for the purpose intended;
4. Be positioned a minimum of 3 feet below water surface when in use and extend beyond the deck a minimum of 3 feet when in use; and
5. Be free of sharp edges or pinch points.

7.6.2 Diving Stages

Diving stages shall:

1. Be capable of supporting the weight of two divers plus their gear;
2. Be made of corrosion-resistant material;
3. Be provided with a safety chain and internal hand-holds for dive safety during launch and recovery;
4. Be suitable for the purpose intended;
5. Make provisions for mounting of breathing gas cylinder and regulator for emergency breathing at all depths of intended operation; and
6. Have a “man-rated” lifting system

7.7 PRESSURE VESSELS FOR HUMAN OCCUPANCY (PVHOs)

7.7.1 Diving Pressure Vessels

The following are minimum requirements for PVHOs:

A. Equipment shall be constructed in accordance with USCG regulations, ASME PVHO-1, and/or a classing society competent in PVHO diving systems and shall be subject to planned maintenance system;

B. Each pressure Vessel, including each volume tank, cylinder, PVHO, and pressure Vessel piping, shall be examined and tested annually for mechanical damage or deterioration and shall likewise be examined and tested after any repair, modification, or alteration, with results of the examinations entered into the log;

C. The following tests shall be conducted at least every 3 years:

   1. All piping permanently installed on a PVHO,
   2. A leak test at the MAWP using the breathing mixture normally used at service, and

D. Be subject to and pass:

   1. A pneumatic test to MAWP annually.
   2. Hydro test to the code to which it was built every fifth year or after an alteration or repair to the pressure boundary.
   3. Unless otherwise noted, pressure tests conducted in accordance with this section shall be either hydrostatically tested or pneumatically tested.

E. When a hydrostatic test is conducted on a pressure Vessel, the test pressure shall be less than 1.25 times the MAWP;

F. When a pneumatic test is conducted on a pressure Vessel, the test pressure shall be the maximum stamped on the nameplate;

G. When a pneumatic test is conducted on piping, the test pressure shall be no less than 90% of the setting of the relief device;

H. Pressure tests shall be conducted only after suitable precautions are taken to protect personnel and equipment;

I. Pressure tests shall be maintained for a period of time sufficient to allow examination of all joints, connections, and high stress areas;

J. All test results must be entered in the equipment maintenance log;

K. PVHOs shall have acrylic windows that are designed, manufactured, inspected, tested, maintained, repaired, and replaced in according to ASME PVHO-1-2012 Safety Standards for Pressure Vessels for Human Occupancy, 2012 Edition.

7.7.2 Recompression Chambers

Recompression chambers shall:

1. Be dual-lock and multi-place, except emergency rescue chambers or chambers designed to mate with another PVHO;
2. Have sufficient internal dimensions to accommodate a person lying in a horizontal position with another person attending (except in designated diving bells, transfer-locks and emergency rescue chambers);
3. Allow ingress and egress of personnel and equipment while the occupants remain pressurized;
4. Have all doors that are fitted with integral locking/dogging mechanisms, other than shipping dogs, operable from both sides of the door;
5. Have sufficient exterior illumination to allow operation of any internal controls and allow for visual observation, diagnosis, and/or medical treatment;
6. Have a visible capability that allows the interior to be observed from the exterior;
7. Have a minimum pressure capability of 6 ATA (165 fsw) or the maximum depth for the dive for dives deeper than 9 ATA (264 fsw);
8. Be capable of a minimum pressurization rate of 2 ATA per minute to 60 fsw and at least 1 ATA per minute thereafter;
9. Be capable of a decompression rate of 1 ATA per minute to 33 fsw;
10. Have a means to maintain an atmosphere below a level of 25% oxygen by volume;
11. Have a means of maintaining an atmosphere below 2% surface equivalent carbon dioxide by volume;
12. Have monitors if no means is available to maintain an atmosphere below a level of 25% oxygen and 2% carbon dioxide;

13. Have mufflers/silencers on blow-down and exhaust outlets;
14. Have suction guards on exhaust line openings inside each compartment;
15. Have piping arranged to ensure adequate circulation to ensure non-strata;
16. Have all installed flexible hoses meet the requirements of *Section 7.4.1;*
17. Have all penetrations clearly marked as to service;
18. Have piping in accordance with ANSI Code B31.1 and/or ASME/PVHO 1990 or classification society to which it was built;
19. Have a dedicated pressure gauge indicating depth for each pressurized compartment;
20. Have a calibration of each depth gauge within 6 months;
21. Be arranged so as to allow comparison with another gauge while in operation;
22. Have a pressure relief device as per ASME/PVHO-1 or the code of construction;
23. Have the pressure relief valve setting tested annually and the test recorded in the equipment log;
24. Have an installed breathing system with a minimum of one mask per occupant, per lock plus one spare mask per lock;
25. Have a non-return valve on through-hull penetrators supplying any BIBS;
26. Have a two-way voice communications system between the occupants and the operator, as well as between other occupants in separate compartments of the same PVHO or an attached PVHO; this may be a sound-powered phone system;
27. Have a speech descrambler when used with mixed gas;
28. Be equipped with a readily available means for extinguishing a fire;
29. Chamber exhaust should not vent into an enclosed space;
30. The chamber, its general area and controls should be adequately illuminated for operations at night;
31. When fitted, have electrical systems designed for the environment in which they will operate;
32. If external lights are used to illuminate the chamber internally, they shall not be placed in a manner that would subject viewports to heat build-up;
33. If the chamber is located away from dive control station, there must be a suitable means of communications between the two locations;
34. Have hearing muffs provided in chamber for hearing protection.

7.8 GAUGES

A. Gauges used with diving equipment or systems shall:

1. Be suitable for the purpose intended; and
2. Be rated as cleaned for oxygen use when installed in oxygen systems.

B. When used to indicate a diver's depth, gauges shall:

1. Be of the appropriate range and gradation;
2. Be gradated in units consistent with the decompression tables;
3. Be checked for calibration every 6 months;
4. Be marked with a label, tag, or sticker indicating date of last calibration and due date that will not interfere with full-scale visibility;
5. Have a tag or label indicating amount of deviation (±) to the calibration standard;
6. Have calibrations documented in the equipment cal log; and
7. A pressure-limiting device may be fitted to avoid gauges being over-pressurized.

7.9 TIMEKEEPING DEVICES

Devices used to monitor a diver's exposure time under pressure shall:

1. Be suitable for purpose and easily read;
2. Be consistently used during the course of an operation.
3. Be compared against known standard every 6 months;
4. Not be used when there is an error exceeding 15 seconds in 4 hours.

7.10 COMPRESSED GAS EQUIPMENT

7.10.1 Volume Tanks/Air Receivers

Volume tanks used in diving systems shall:

1. Be designed, fabricated, inspected, tested, and certified in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Ship Code Section VIII, Div. I "Unfired Pressure Ships," and/or other statutory classification society requirements;
2. Be equipped with a pressure gauge;
3. Be equipped with a non-return valve on the inlet side;
4. Be equipped with a relief valve as required by code of the manufacturer;
5. Be equipped with condensate drain valve located at its lowest point;
6. Be equipped with slow opening valves when used with design pressures exceeding 500 psig;
7. Be cleaned for oxygen service and have slow opening valves when used in systems containing greater than 40% oxygen;
8. Be inspected internally and externally at least annually for damage or corrosion;
9. Be pneumatically tested to MAWP annually, using the normal breathing mixture;
10. Be hydro tested to 1.5 MAWP every 5 years or after any repair, modification, or alteration to the pressure boundary and stamped with the test date; and
11. Have a unique identity with results of all tests being recorded in the equipment log.

7.10.2 Gas Storage Cylinders and Tubes

High pressure gas cylinders or tubes shall:

1. Be manufactured to recognized code of standard;
2. Be equipped with an over- pressure relief device;
3. Be visually examined annually for damage or corrosion;
4. If rack-mounted into banks of cylinders or tubes, have valves and regulators protected from damage caused by impact of falling items;
5. Be hydrostatically tested to 1.5 times MAWP every 5 years and stamped with the test date;
6. If used underwater, be inspected internally and externally, at least annually, for damage or corrosion;
7. Have contents labeled. Fire hazard warning signs should be erected in vicinity of stored oxygen;
8. Be stored in a well-ventilated area, protected from overheating;
9. Be positively secured from falling; and
10. All single cylinder manifolds shall be capped when not in use.

7.10.3 Bail-out Bottles

High-pressure bottles used for bail-out shall:

1. Be manufactured to recognized standard or code;
2. Be equipped with an over-pressure relief device;
3. Be visually inspected by diver prior to use.
4. Be inspected internally and externally at least annually for damage and corrosion; and
5. Be hydrostatically tested every 5 years to the requirements of the code of manufacture by an authorized test facility and stamped with the date of test.

8.0 EMERGENCY PROCEDURES

8.1 GENERAL REQUIREMENTS

All AOR operations shall have documented procedures to ensure that immediate and effective actions are taken in emergency situations. The following procedures and plans shall be prepared:

A. Worksite specific emergency procedures (emergency procedures may be found in Appendix E);

B. A medical emergency plan describing the interrelation between the shore-based health services and the onboard team;

C. An overall contingency plan describing actions required to support the vessel or work site in case of a hazardous situation that cannot be solved directly on board; and

D. A contingency training plan describing the actions required to train all relevant personnel in order to maintain a high level of contingency preparedness.

8.2 CONTINGENCY PLANNING

A. All work sites shall have a documented contingency plan that describes all measures taken to prepare for any foreseeable incident requiring assistance not available on the Vessel or work site. This plan shall describe the organization, watch systems, medical support, and logistics of hyperbaric evacuation and of transporting sick or injured personnel ashore and/or qualified medical personnel on board.

B. The contingency plan shall also include contact numbers for all relevant persons and/or institutions capable of assisting in emergency situations. These contact numbers shall be current.

9.0 MANAGEMENT OF DIVING AND DECOMPRESSION INCIDENTS

9.1 PHYSIOLOCIGAL PROBLEMS IN DIVING

Physiological problems often occur when divers are exposed to the pressures of depth. Some of these problems may be the result of pressure and decompression, or related to equipment failures, workload, and environmental causes. Some of these problems include:

1. Hypoxia

2. Hypercapnia
3. Asphyxia
4. Drowning
5. Carbon Monoxide Poisoning
6. Middle Ear / Sinus Squeeze
7. Nitrogen Narcosis
8. Dehydration
9. Thermal Problems
10. Oxygen Toxicity
11. Pulmonary Over-Inflation Syndromes
12. Decompression Sickness (DCS)

9.1.1 Hypoxia

Hypoxia is an abnormal deficiency of oxygen (O2) in the arterial blood.

Causes:

- Improper breathing gases or low oxygen in the breathing gas supply.
- Collapse of lung due to pneumothorax.
- Excessive breath holding.

Symptoms:

- Loss of judgment.
- Lack of concentration.
- Lack of muscle control.
- Drowsiness.
- Loss of consciousness.

Treatment:

- If on surface, administer 100% oxygen.
- If in water, ventilate and/or switch gas supply.

9.1.2 Hypercapnia

An abnormally high level of carbon dioxide (CO2) in the blood and tissues.

Causes:

- Inadequate helmet ventilation.
- Excessive over-breathing of the gas supply by the diver.

Symptoms:

- Increased breathing rate.
- Shortness of breath, sensation of difficulty breathing or suffocation.
- Confusion.
- Inability to concentrate.
- Headache.
- Cyanosis (bluish hue of skin and lips)
- Loss of consciousness.

Treatment:

- Decrease level of exertion to reduce CO2 production.
- Increase helmet ventilation (a long vent of 1 or 2 minutes)
- Shift to an alternate breathing source if equipment cause is suspected.

9.1.3 Asphyxia

A condition where breathing stops and both hypoxia and hypercapnia occur simultaneously. Asphyxia will occur when there is no gas to breathe or when the airway is completely obstructed.

9.1.4 Drowning

Fluid induced asphyxia. Drowning while in a helmet is rare but can happen if the helmet is not properly secured and comes off, or if the diver is trapped in a head-down position with a water leak into the helmet. Rescue breathing should be started on a drowning victim as soon as possible.

9.1.5 Carbon Monoxide Poisoning

Occurs when carbon monoxide (CO) in the blood exceeds normal levels. CO is taken up by the red blood cells in preference to oxygen, thereby blocking the cells ability to deliver oxygen to the body tissues.

Causes:

- Contaminated breathing gas usually due to the compressor intake being contaminated by engine exhaust fumes.
- Breathing CO produced by welding rods in a dry habitat.

Symptoms:

- Headache.
- Nausea.
- Dizziness /confusion.
- Cherry red coloration of the skin, tongue, and lips.
- Loss of consciousness without warning.

Treatment:

- Switch to a clean air or gas source.
- Breathe fresh air.
- Administer 100% O2 and transport to hyperbaric chamber.
- Consider Treatment Table 5 after consulting hyperbaric physician.

9.1.6 Middle Ear / Sinus Squeeze

Pain and barotrauma cause by pressure differentials in middle ear and/or sinus cavities. This squeeze or barotrauma usually occurs during descent, but may occur during ascent. Middle ear squeeze is the most common and is caused by a blockage of the Eustachian tubes and inability of pressure to equalize with the pressure on the outside of the eardrum caused by depth and pressure.

If squeeze is noticed during the descent, the diver shall stop, ascend a few feet and gently perform a Valsalva maneuver (closing his mouth and nose and then exhaling). If clearing cannot be accomplished after a few attempts, abort the dive. NEVER descend if squeeze of any type occurs and cannot be resolved.

Caution must be exercised during descent (blow down) in a decompression chamber. the chamber operator should visually monitor the diver during descent and prepare to stop descent if the diver experiences squeeze.

9.1.7 Nitrogen Narcosis

A state of stupor or euphoria caused by diving air at deep depths. The high partial pressure of nitrogen (N_2) in the air produces a narcotic effect in susceptible individuals. The effects may first become noticeable at a depth of 100 fsw, but become more pronounced at depths greater than 150 fsw. The diver usually experiences a sensation of euphoria with apprehension, confusion, impaired judgment, and a false sense of well-being. Concentration or performance of even simple tasks is difficult. Therefore, the diving supervisor should closely monitor the dive and the effects of possible nitrogen narcosis on the diver in order to ensure safety.

9.1.8 Dehydration

Excessive loss of water in the body tissues and resulting electrolyte imbalance. Dehydration is a concern to divers, particularly in hotter climates, while diving hot water suits, or diving in high temperature water environments. the diver may experience lightheadedness or faint while attempting to climb out of the water or feel fatigued and less alert. Divers should monitor their fluid intake and ensure they keep themselves well hydrated.

9.1.9 Thermal Problems

In diving, can be either hypothermia (excessive heat loss) or hyperthermia (excessive heat gain). These thermal problems, arising from exposure to various temperatures pose a major consideration when planning operational dives and selecting equipment.

Hypothermia is a lowering of the core temperature of the body. In mild cases, the victim will experience uncontrolled shivering, slurred speech, imbalance, and poor judgment. Severe cases are considered a medical emergency.

Treatment:

- Remove all wet clothing.
- Wrap victim in a blanket.
- If possible, place in a warm area (galley, engine room, etc.)
- For severe cases, seek immediate medical attention.

Hyperthermia is an excessive raising of the core temperature of the body. Hyperthermia should be considered a potential risk any time the air temperature exceeds 90ºF or water temperature is above 82ºF. The most common signs and symptoms are high breathing rate, feeling of being hot, low urine output, fatigue and nausea. Severe cases are considered a medical emergency.

The treatment of all cases of hyperthermia shall include cooling the victim to reduce core temperature. Removing clothing and spraying with a fine mist of cool water, and then fanning should be initiated. Avoid whole body immersion in cold water or packing the body in ice as this will cause vasoconstriction which may slow the loss of heat.

9.1.10 Oxygen Toxicity

Can be a concern whenever exposed to a partial pressure of oxygen (ppO_2) greater than that in normal daily living. The extent of the toxicity is dependent on both the oxygen partial pressure and the exposure time. Pulmonary toxicity can occur whenever the ppO_2 exceeds 0.5 ata. Long exposures exceeding 12 hours at .5 ata may produce symptoms of a burning sensation in the lungs progressing to pain and coughing upon inhalation. The only method of resolving these symptoms is to reduce the ppO_2 in mixed gas or NITROX, and to reduce exposure times.

Central Nervous System (CNS) oxygen toxicity can occur whenever the ppO_2 exceeds 1.3 ata in a wet diver and 2.4 ata in a dry diver, as in a decompression chamber.

Symptoms (CNS oxygen toxicity):

- **V**isual disturbances: tunnel vision, blurred vision, loss of peripheral vision.
- **E**ar Symptoms: ringing, roaring, or pulsing sound in the ears.
- **N**ausea
- **T**witching: of small muscles, especially the facial muscles, lips, etc.
- **I**rritability
- **D**izziness
- **C**onvulsions. This may be the first sign which occurs with little or no warning.

A convulsion is the most serious consequence of CNS oxygen toxicity. This can occur in the decompression chamber without warning. The chamber operator should be aware of signs of oxygen toxicity of a decompressing diver. During this type of convulsion, the individual loses consciousness and a tonic phase seizure followed by a clonic phase seizure usually occurs. The treatment for any oxygen toxicity symptom is to ascend or shift to a breathing mixture with a lower ppO_2, if in the water. Do not attempt to ascend a diver in the water during a clonic phase seizure. During this phase, the victim is probably not breathing, and any change in depth may result in an arterial gas embolism (AGE). In a recompression chamber, the BIBS masks should be removed as soon as possible and breathing of oxygen switched to air.

9.1.11 Pulmonary Over-Inflation Syndromes

Pulmonary over-inflation syndromes are a group of pressure related diseases caused by the expansion of gas trapped in the lung during ascent or over pressurization of the lung with subsequent rupture of the alveolar sacs. When the alveolar sacs rupture, the route that the escaping gas takes determines which of the three main over-inflation syndromes develop in the diver:

A. Arterial Gas Embolism (AGE)
B. Pneumothorax
C. Mediastinal and Subcutaneous Emphysema

Arterial Gas Embolism (AGE)

AGE is caused by entry of gas bubbles into the arterial circulation as a result of pulmonary over-inflation and rupture of the alveolar sacs in the lungs. These gas bubbles enter the blood stream, which go directly to the heart and up the main arteries to the brain and/or central nervous system. At the brain, the bubbles lodge in smaller vessels and halt blood flow. The onset of symptoms is very rapid and occurs normally within 10 minutes after surfacing, but the onset can manifest itself within 20 minutes. AGE is a medical emergency.

Symptoms:

- Unconsciousness.
- Convulsions.
- Stroke-like symptoms (paralysis in extremities).
- Pain in chest.
- Extreme fatigue.
- Dizziness.
- Coughing up blood.
- Leibermeister's sign (a sharp defined area of pallor on the tongue).

Treatment:

- IMMEDIATE RECOMPRESSION (use treatment flowchart Figure 20-1 Treatment of Arterial Gas Embolism or Serious Decompression Sickness).
- Keep patient inclined lying with head lower than feet if possible.
- If chamber is not available, administer 100% O_2 and transport to nearest hyperbaric chamber.

Pneumothorax

A pneumothorax is gas trapped in the pleural space between the lungs and chest wall. The gas trapped in this space will cause an organ (lung and/or heart) shift causing the lung to collapse and impair heart function. It may occur without the associated arterial gas embolism. During ascent (in the water or decompression chamber) the gas will expand exponentially placing more pressure on the lungs and heart. If a pneumothorax occurs under pressure, halt the ascent immediately.

Symptoms:

- Sudden sharp chest pain.
- Shortness of breath and labored breathing (rapid shallow breaths).
- Weak pulse.
- Absence of breathing sounds on the injured side.
- Leaning toward the injured side and supporting the chest (splinting).

Treatment:

- Recompression is NOT indicated, unless associated with gas embolism.
- Prepare the patient for medical evacuation and higher medical care.
- If pneumothorax occurs in a decompression chamber, halt the ascent immediately. Failure to do so may result in a fatality.
- Contact hyperbaric physician immediately for further guidance.

Mediastinal and Subcutaneous Emphysema

Emphysema refers to misplaced gas in the body resulting rupture within the lung due to over-inflation. Mediastinal emphysema occurs when gas is forced through torn lung tissue into the middle of the chest. Mild cases are often unnoticed by the diver but sever cases are indicated by a moderate or dull ache under the breastbone. Subcutaneous emphysema occurs when gas subsequently migrates into tissues under the skin, usually in the neck area. Signs and symptoms include swelling around the neck, a voice change due to pressure. Pressing on the skin around the neck may produce a cracking or crunching sound (crepitation).

Treatment:

- Rule out the coexistence of arterial gas embolism or pneumothorax.
- Recompression is usually not indicated, unless associated with gas embolism.
- Administer 100% O_2 on the surface. 1 hour of breathing oxygen should be sufficient for resolution.
- Shallow treatment in the chamber may be used if the diver is in respiratory distress. Usually 1 hour of oxygen breathing at 10 fsw is sufficient for resolution.
- Following any treatment for emphysema requires further medical evaluation.

9.1.12 Decompression Sickness (DCS)

Decompression sickness (DCS) results from the formation of bubbles in the blood or body tissues and is caused by inadequate decompression following a dive or other exposure to high pressure. Inadequate decompression may occur even when normal safe decompression regimes are followed and all precautions are observed. Abnormal conditions in the diver or his surroundings, sometimes impossible to detect or prevent may cause him to absorb excess gas or inhibit natural elimination of dissolved gas during normal decompression. Any decompression sickness that occurs MUST be treated by recompression.

For the purpose of deciding the appropriate treatment, symptoms of decompression sickness are generally divided into two categories, Type I and Type II.

Onset of Symptoms

DSC symptoms usually occur shortly following the dive or pressure exposure. If the controlled decompression during ascent is omitted, DCS symptoms can occur in the water prior to reaching the surface. In analyzing several thousand air dives, the U.S. Navy calculated the time of onset of symptoms after surfacing:

- 42% occurred within 1 hour.
- 18% occurred between 1 hour and 3 hours.
- 23% occurred between 3 hours and 8 hours.
- 15% occurred between 8 hours and 24 hours.
- 2% occurred after 24 hours.

Type I Decompression Sickness Symptoms

Symptoms:

- Skin bends (itching, skin rash, marbled skin).
- Joint pain (localized and pain only), most commonly a deep, dull ache in a shoulder joint, elbow, wrist, hand, knee or ankle.
- Swelling or pain in lymph nodes.

Treatment:

- Administer Rapid Neurological Exam Check prior to recompression.
- Follow treatment flowchart Figure 20-2 Treatment of Type I Decompression Sickness.

Type II Decompression Sickness Symptoms

1. Neurological Symptoms (Central Nervous System)

- Numbness in an extremity.
- Muscle weakness, paralysis of any body part.
- Pain that radiates down an extremity.
- Pain in two or more joints.
- Tingling sensation (pins and needles).
- Severe pain of the abdomen and around the trunk of the body.
- Visual disturbances.

2. Cardiopulmonary Symptoms (the “chokes”)

- Begins as chest pain.
- Increasing breathing rate.
- Increasing lung congestion.
- Complete circulatory collapse, loss of consciousness.

Treat all cases of DCS IAW paragraph 9.4

DECOMPRESSION SICKNESS PREVENTION

Although decompression tables have evolved to a point where the risk of decompression sickness has been considerably reduced, it cannot be completely ruled out. Even when following standard diving profiles, due to variations in individual physiology and work conditions, a diver may develop symptoms following any dive. Diving supervisors and divers should be aware of some of the factors which may affect decompression:

- Pneumofathometer gauge error.
- Improper decompression profile planning.
- Sea state / heavy seas.
- Diver fatigue.
- Excessive work load.
- Age / physical condition of the diver.
- Dehydration in the diver.
- Exercise/ work during decompression in water.
- Exercise during decompression in the chamber.
- Body position which may restrict blood flow while in decompression chamber (e.g. sitting on

hands, etc.)

- Recent soft tissue injury.
- Alcohol intake or the aftereffects of recent alcohol intake.

9.2 DECOMPRESSION SICKNESS ASSESSEMENT

It is the diving supervisor's responsibilities to assess the condition of each diver following a dive for signs of decompression sickness and pulmonary over-inflation syndromes. The diver has the responsibility to report all symptoms to the diving supervisor no matter how minor they may appear. The diver shall report all symptoms early, which may avoid more serious symptoms appearing later. For all symptoms and all suspected symptoms, the Manager of Diving Operations and the EHS Manager shall be contacted.

It is important that in every case of suspected Type I DCS, an *Initial Neurological Examination Check* (see *Appendix F – Dive and Treatment Tables*) shall be performed to assess the diver's condition prior to treatment. If a neurological examination is not conducted the diver will be considered as having Type II DCS. All signs and symptoms should be reported promptly to the diving supervisor.

The *Rapid Neurological Examination Check* is intended as a quick examination to identify any potential signs of decompression sickness. This examination is suggested following any decompression dive and required following chamber decompression for any mixed-gas dive.

The *Rapid Neurological Examination Check* should also be used for periodic examination of a diver undergoing treatment for decompression illness in the chamber. Periodic exams should be administered prior to and following each depth change, upon surfacing from the chamber and, one to two hours following completion of the treatment.

In all cases of suspected TYPE II DCS or Pulmonary Over-Inflation Syndromes, recompress the diver immediately. The inside tender shall perform a Rapid Neurological Exam at depth in the chamber and prior to any change in depth. It is recommended that the exam be conducted at 30-minute intervals during treatment.

If the reason for post dive symptoms is FIRMLY established due to other causes other than decompression sickness or arterial gas embolism (e.g. injury, sprain, etc.), then recompression is not necessary. If the diving supervisor cannot rule out decompression sickness or arterial gas embolism with 100% certainty, then treatment shall commence.

9.3 ASYMPTOMATIC OMITTED DECOMPRESSION

Certain emergencies, such as uncontrolled ascents, an exhausted air supply, or bodily injury may interrupt or prevent required decompression. In some unplanned omitted decompression omitted decompression, the diver may suddenly appear on the surface without warning or communication to the diving supervisor. Even if the diver shows no symptoms, omitted decompression must be addressed in some manner to avert later difficulty.

Table 9-3 summarizes management of asymptomatic omitted decompression.

Table 9-3. *Management of Asymptomatic Omitted Decompression.*

Deepest Decompression Stop Omitted	Surface Interval (Note 1)	Action	
		Chamber Available (Note 2)	**No Chamber Available**
None	Any	Observe on surface for 1 hour	
20 or 30 fsw	Less than 1 min	Return to depth of stop. Increase stop time by 1 min. Resume decompression according to original schedule.	
	1 to 7 min	Use Surface Decompression Procedure (Note 3)	Return to depth of stop. Multiply 30 and/or 20 fsw air or O_2 stop times by 1.5.
	Greater than 7 min	Treatment Table 5 if 2 or fewer SurDO_2 periods Treatment Table 6 If more than 2 SurDO_2 periods	
Deeper than 30 fsw	Any	Treatment Table 6 (Note 4)	Descend to depth of first stop. Follow the schedule to 30 fsw. Switch to O_2 at 30 fsw if available. Multiply 30 and 20 fsw air or O_2 stops by 1.5.

Notes:
1. For surface decompression, surface interval is the time from leaving the stop to arriving at depth in the chamber.
2. Using a recompression chamber is strongly preferred over in-water recompression for returning a diver to pressure. Compress to depth as fast as possible not to exceed 100 fsw/min.
3. For surface intervals greater than 5 minutes but less than or equal to 7 minutes, increase the oxygen time at 50 fsw from 15 to 30 minutes.
4. If a diver missed a stop deeper than 50 fsw, compress to 165 fsw and start Treatment Table 6A.

If the diver makes an uncontrolled ascent to the surface at a rate greater than 30 fsw/min, but the dive itself is within no-decompression limits, the diver should be observed on the surface for 1 hour to ensure that symptoms of decompression sickness or arterial gas embolism do not develop. Recompression is not necessary unless symptoms develop. For omitted decompression stops of 20 fsw or deeper, refer to *Table 9-3.*

9.4 DECOMPRESSION SICKNESS TREATMENT

Based on the diagnosis, the diving supervisor shall choose a treatment scheme and follow guidelines in the decompression sickness flowcharts provided (See *Appendix E - Dive and Treatment Tables*.) It should be noted that the treatment schemes rely exclusively on U.S. Navy treatment tables and protocols. Never deviate from the flowchart paths or schedules and do not attempt to shorten or modify them without the guidance of a hyperbaric physician. For any planned treatment, the Manager of Diving Operations and EHS Manager shall be contacted. It is also noted that a hyperbaric physician should be contacted when treating decompression sickness.

For all treatments, an inside tender (qualified to work in hyperbaric environments) shall remain in the chamber for the entire course of the treatment. The supervisor shall follow the decompression protocols specified in the treatment table and applicable flow chart(s).

Dive and Treatment tables are in Appendix F:

Decompression Sickness Treatment Flowcharts

Figure 20-1: Treatment of Arterial Gas Embolism or Serious Decompression Sickness.
Figure 20-2: Treatment of Type I Decompression Sickness.
Figure 20-3: Treatment of Recurrence of Symptoms.

Decompression Sickness Treatment Tables

Figure 20-4: Treatment Table 5.
Figure 20-5: Treatment Table 6.
Figure 20-6: Treatment Table 6A.
Figure 20-7: Treatment Table 4.
Figure 20-8: Treatment Table 7.

9.5 EMERGENCY CONSULTATION

In all cases, contact the Diving Operations Manager and C/H&S Manager as soon as possible.

Emergency consultation is available 24 hours a day via:

Primary: Diver's Alert Network - 919-684-9111

Secondary: Navy Experimental Diving Unit (NEDU)
Commercial (850) 230-3100 or (850) 235-1668

9.6 POST DIVE REQUIREMENTS

After surfacing from a dive, divers remain at risk decompression sickness for at least 24 hours. Divers must therefore follow the post-dive/post chamber requirements shown in Table 9.1.

As a precautionary measure against the occurrence of decompression sickness, a diver must remain awake and within the vicinity of the chamber for a minimum period of 1 hour following a decompression dive.

Table 9.1 Post-dive requirements.

Type of Hyperbaric Exposure	Time (Hours) Diver Must Remain In…	
	Immediate Vicinity [1]	General Vicinity [2]
Any surface dive requiring decompression	**1**	**12**
Any saturation dive	**24**	**N/A**

[1] Direct access to the chamber (e.g., on the vessel or at the jobsite).
[2] Within 30 minutes' travel time to a chamber.

9.6.1 Flying in a Pressurize Aircraft after Diving

Due to pressures in commercial aircraft (less than sea-level pressures), flying after diving has wait time limits. Table 9.2 lists the minimum required surface interval prior to flying in a pressurized aircraft following hyperbaric exposure.

Table 9.2 Required Surface Interval for flying in a pressurized aircraft after diving

Diving Mode	Highest Repet Group Letter obtained in previous 24 hours	Time (Hours)
Air diving w/ no-decompression	**A - H**	**12**
Air diving w/ no-decompression	**I - Z**	**24**
Air diving with decompression	**All**	**24**
Mixed-gas surface diving	**n/a**	**24**
Heliox (HeO2) saturation diving	**n/a**	**24**
Any decompression sickness	**n/a**	**48**
Extreme Exposure (Emergency) dive	**n/a**	**48**

9.6.2 Flying in an Unpressurized Aircraft After Diving

Flying in an unpressurized helicopter or other aircraft after diving also requires a surface interval following hyperbaric exposure. This includes flying after diving in any unpressured aircraft above and altitude of 1000 feet, or any land travel to altitudes in excess of 1000 feet above sea level. For all scenarios, refer to U.S. Navy Diving Manual – Rev. 7, *Table 9-6 Required Surface Interval Before Ascent to Altitude.*

9.6.3 Diving After Decompression Sickness

Assessing fitness to return to diving after decompression sickness shall be in accordance with *Section 4.5.*

10.0 OPERATIONAL REPORTING REQUIREMENTS

10.1 GENERAL REPORTING REQUIREMENTS

A. The structure of the AOR reporting system is based on the following:

1. Statutory requirements;
2. AOR internal requirements;
3. Client requirements; and
4. Project procedures and reporting requirements.

B. The following reports may be generated during the course of any project:

1. Dive sheets;
2. Chamber logs;
3. 24-hour job log;
4. Pre-shift safety meeting;
5. Activity Hazard Analysis (AHA);
6. Incident/injury reports;
7. DCI treatment sheet; and
8. Rapid Neurological Exam Checklist

10.1.1 Recordkeeping and Reporting Requirements

At a minimum, the Recordkeeping and Reporting Requirements shall include the following:

1. Project description / work scope;
2. Task and/or accomplishment record of completion with timeline;
3. Dive log and decompression records;
4. Incident/injury reports, including any report of decompression illness and treatment;

10.2 DIVING REPORTS AND RESPONSIBILITIES

10.2.1 Dive Log / Sheet

A dive log (dive sheet) is required for every dive, regardless of depth or bottom time. The dive sheet is differentiated from the required diver maintained dive log in that the dive sheet is a company record of diving activity. Requirement of the dive log and blank dive sheets may be found in *Appendix B: Dive Briefs, and Logs*.

A. The diving supervisor on watch is responsible for the dive and, as such, shall sign the Dive Sheet. If a dive is in progress at the time when supervisors change shifts, the outgoing supervisor shall sign the logs and record the time of the handover. The incoming supervisor shall also sign the logs at the completion of the dive. A note of the shift changes and names of the diving supervisors shall be recorded on the Dive Sheet, as well as recorded in the Diving Operations Log.

B. When mixed-gas diving operations are conducted, the logs shall detail various environmental parameters, such as stage depth, on-board gas supply, and diver on-line and reserve breathing gas mixtures and pressures.

10.2.2 Chamber Log

The Chamber Log shall provide a record of the divers' exposure to the hyperbaric environment in the chamber. It is used to record specific information regarding the time and depths of exposure in the chamber, the names of the persons responsible for the operation of the chamber system, and the specified oxygen exposure times. Blank chamber log sheets are included in *Appendix B: Dive Briefs, and Logs*.

In surface diving, the chamber log, or chamber sheet, is filled out by the diving supervisor or qualified chamber operator. The diving supervisor is responsible for the accuracy of the decompression table or treatment table.

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Appendix A: JOB HAZARDS AND CONTROLS

Job Hazards and Controls

This appendix lists operation and environmental hazards and possible controls to mitigate risk. Use this appendix when performing Activity Hazard Analysis for the specific hazards of a particular jobsite and work task(s). The AHA Worksheet Form shall be used, and names of participants shall be listed on the form.

The order of precedence and effectiveness of hazard control is:

1. Engineering controls.
2. Administrative controls.
3. Personal protective equipment.

A. Engineering controls include the following:

- Elimination/minimization of the hazard—Designing the facility, equipment, or process to remove the hazard, or substituting processes, equipment, materials, or other factors to lessen the hazard;
- Enclosure of the hazard using enclosed cabs, enclosures for noisy equipment, or other means;
- Isolation of the hazard with interlocks, machine guards, blast shields, welding curtains, or other means; and
- Removal or redirection of the hazard

B. Administrative controls include the following:

- Written operating procedures, work permits, and safe work practices;
- Exposure time limitations (used most commonly to control temperature extremes and ergonomic hazards);
- Monitoring the use of highly hazardous materials;
- Alarms, signs, and warnings;
- Buddy system; and
- Training

C. Personal Protective Equipment—such as respirators, hearing protection, protective clothing, safety glasses, and hardhats—is acceptable as a control method in the following circumstances:

- When engineering controls are not feasible or do not totally eliminate the hazard;
- While engineering controls are being developed;
- When safe work practices do not provide sufficient additional protection; and
- During emergencies when engineering controls may not be feasible.

Must consider the cumulative effects of multiple hazards on the team's ability to function. Also, must consider the potential supportive or canceling effects of multiple controls.

ENVIRONMENTAL HAZARDS AND CONTROLS

SURFACE WEATHER / CONDITIONS.

Surface conditions affect both the divers and topside team members. Conditions for the area of operations can be determined from special charts that show seasonal variations in temperature and wind. Weather reports and long-range weather forecasts should be studied to determine likely conditions. Extreme conditions are generally a greater problem for topside personnel than for the diver. Any reduction in the effectiveness of the topside personnel may endanger the safety of the diver.

Surface weather hazards to topside personnel:

Hazard	Effect(s)	Control(s)
Altitude	Altitude sickness	Acclimatization. Reduce activity. Limit exposure.
Sun	Sunburn, sun poisoning, eye damage.	Provide shelter/awnings. Wear sunscreen, long shirts, pants, hats, sun glasses.
Wind	windburn, flying debris, wind chill	Provide shelter. Wear lib and face balm, long shirts, pants, eyewear
Cold	Chilling, hypothermia, frostbite. Frozen equipment	Provide shelter/heating. Wear appropriate thermal protection. Rotate personnel. Ensure winterization, preparation of equipment for use in cold environment IAW manufacture recommendations.
Heat	Heat exhaustion, Hyperthermia	Provide shelter with cooling, dive early or late in the day. Wear light, loose clothing. Hydrate.
Reduced surface visibility (night operations, rain, fog, haze…)	Loss of situational awareness, lack of visibility to other craft. Surface craft running over diver on the surface.	Use of radar reflector, surface flood/area lights, suspend/limit operations,
Lightning	Electrical shock,	Plan operations around known severe weather periods. Suspend operations.
Wet, slippery surfaces	Slips, falls	Use sand or mats to increase traction. Tenders control dressed divers
Uneven surfaces, hoses / cables on the ground	Trips, falls	Provide dunnage or other material to cover uneven surfaces. Provide handrails on or near uneven surfaces. Plan dive site setup to minimize hoses / cable on the ground. Use cable trays, route hoses in overhead. Tenders control dressed divers
Marine life	Injury, venomous/poisonous sting	Use of trappers / local experts. Limit exposure during know feeding/ breeding times. Situation awareness. PPE / Physical barriers (shark cage).

Notes on surface weather / conditions:

Cold conditions pose a unique stress on a dive team and often the topside personnel are at more risk for cold injuries than the diver. Adequate thermal protection for the divers is a given. Due care and concern for the protection of topside personnel must be planned to avoid a distracted workforce.

- Protection of equipment from freeze damage during and post dive must be taken to ensure continued diving. All personnel should be on guard for the symptoms of cold injuries and take appropriate precautions.

- Adequate hydration of divers is just as important in cold climates as in hot.

Refer to the USN Dive Manual for additional guidance for diving in cold or ice-covered water.

Diving in hot climates generally brings the threat of thunderstorms and lightning as well as heat injuries. Diving supervisors should monitor storms via weather radio or available technology.

- Every five (5) seconds from the sight of lightning until the audible thunder equals one (1) mile. Diving should be suspended if lightening is with six (6) miles or 30 seconds (10 miles or 50 seconds for USACE operations), until the lightning has passed for 30 minutes (30 – 30 rule.)
- All personnel should be on guard for the symptoms of heat injuries and take appropriate precautions. Divers should drink electrolytes and avoid caffeinated beverages and avoiding overhydrating while diving in warm water.

Refer to the USN Dive Manual for additional guidance for diving in warm water.

Aquatic Environment Hazards to the diver:

Hazard	Effect	Control(s)
Increased depth	DCS, narcosis, dyspnea	Use of remotely operated vehicles. Use of SSA. Match work rate to breathing. Use decompression tables conservatively. Use surface decompression or in-water oxygen.
Cold water	Chilling, hypothermia, dehydration, DCS	Provide / review training for diving in cold/ice covered water. Provide shelter/heating. Wear appropriate thermal protection for the water temperature. Use cold water diving procedures (keep equipment dry, do not purge or breathe on the surface.) Rotate divers. Adequate hydration, food and rest. Limit Caffeine. Use surface decompression.
Warm water	Heat exhaustion, Hyperthermia, DCS, Pulmonary Edema	Use of cooling packs, Rotate divers (limit stay times to reduce exposure)
Ocean or river currents and tides	Increased exertion – DCS. loss of stability, displacement from dive site, entrapment	Plan diving during slack water or times when seasonal water flows are reduced. Plan work to move with current if possible. Use additional weights.
Bottom composition (Mud, debris)	Increased exertion -DCS, diver fouling / entrapment	Use swimming mode if possible. Match work rate to breathing. Use floating umbilical. Plan routes to avoid obstacles.
Low or no visibility	Trapped or lost diver. Diver injury (contact with bottom debris, dangerous aquatic life, pinch / crush	Plan diving in periods with seasonably clear water (low rainfall periods). Use slow deliberate motions. Use PPE (gloves, wetsuit, coveralls)

	injury)	
Wave action	Loss of decompression stop. Pinch / crushing Injury due to hard object contact while entering/ leaving water. Loss of mooring.	Use surface decompression. Plan diving in periods with low or no surface waves. Suspend operations. Use diver stage to enter / leave water. Maintain situational awareness. Use adequate ground tackle to secure mooring.
Contaminated water	Sickness or illness	Proper training on procedures and equipment. Diving in contaminated water requires extensive procedures and equipment. Any diving performed in contaminated water shall be performed with a detailed contaminated water diving plan IAW *Appendix F Contaminated Water Diving Operations*
Altitude	DCS	Use non-diving techniques, ROV. Use altitude table corrections. Limit repetitive diving. Limit deep diving. Adhere to post-dive flying nor driving (over mountains) at altitude.

OPERATIONAL HAZARDS AND CONTROLS

Hazard	Effect	Control(s)
Differential Pressure	Entrapment	Lock out / Tag out. Use of ROV. Use screens, guards over intakes, drains and excavation equipment suction hoses. Situational Awareness for changing conditions that may create a differential pressure situation. Proper training on procedures.
Confined space / penetration	Entrapment	Use of ROV. Use of SSA with/adequate secondary air supply and bailout bottle. Use of tender at the point of entry. Proper training on procedures and equipment
Working with electrically powered equipment	Electric shock	Use lockout / tag out when diving on or near electrical equipment. Use GFCI with A/C powered equipment and ROVs. Proper training on procedures and equipment.
Munitions and Explosives of Concern (MEC)	Overpressure related injury,	Working with and in search of MEC poses a serious risk to topside and underwater personnel. Use only trained personnel. Any diving performed with or in search of MEC shall be performed IAW an approved explosives safety plan IAW *EM 385-1-97.* Proper training on procedures and equipment.
Surface traffic	Diver injury	Notice to mariners, Dive in periods of good visibility, post diver down and alpha signal flags. Post picket boat to ward off traffic. Proper training on procedures and equipment.
Dive Equipment Failure	Loss of air, loss of communications, inability to read depth	Effective maintenance and inspection. Use of secondary air supply and bail out bottles. Know emergency procedures. Know line pull signals. Mark umbilical IAW EM 385-1-1 section 30. Proper training on procedures and equipment.
Working in mid-water column	Loss of depth control – falling; barotrauma.	Proper tending technique. Use staging / hogging line. Avoid using excessive weight. Proper training on procedures and equipment.
Use of lift bags	Loss of depth control – blow up	Proper training. Maintain equipment in good condition. Use remote filling and or lifting. Use of toppling line. Use multiple small lift bags vice one large bag. Use yard and stay technique to limit lift bag travel. Proper umbilical management. Verify umbilical prior to filling. Proper training on procedures and equipment.
Use of dry suits	Loss of depth control: blow up and falling – barotrauma/pulmonary over-inflation.	Proper training. Proper equipment maintenance. Work up dives. Do not carry tools and or equipment - use lift line to lower tools / equipment. Avoid task overload. Avoid use of dry suits in and around debris with sharp edges or puncture possibility. Proper training on procedures and equipment.
Live boating	Diver entanglement - injury, Loss of depth control (pulling diver to surface)	Limit operations to conditions as specified in: ??? Do not perform in rough seas. Perform only during daylight hours. Proper training on procedures and equipment.
Burning / welding operations	Electric shock. Explosion, differential pressure, diver injury due to hot/falling debris	Only use only properly maintained equipment. Use PPE in excellent condition. Do not perform underwater cutting/welding without training. Use proper procedures when using underwater cutting and welding. See ADCI burning and welding SOP. Proper training on

		procedures and equipment.
Lifting / crane operation	Crushing, pinching injury	Use critical lift plan. Establish direct communications between dive supervisor and crane operator. Use hard hat dive rig. Keep diver out from in between rigging – proper umbilical management. Perform lift with diver on the surface.
Use of hydraulic or pneumatic power tools	Fouling of diver umbilical. Physical soft tissue injury.	Use of appropriate manufacturer's recommended safety guards and positive communications with diver. Practice proper umbilical management. Proper training on procedures and equipment.
High – pressure water blasting	Physical soft tissue injury	Use of appropriate manufacturer's recommended safety guards and positive communications with diver. Practice proper umbilical management. Proper training on procedures and equipment.
Welding and burning	Electrocution, burns, flash burns to eyes. Crushing injury due to falling debris. Explosions from trapped gases	Use of proper and well-maintained equipment. Use of proper procedure – keeping the ground close to the work and between diver and electrode. Use of positive communications with diver. Properly secure structure prior to cutting away. Adequate venting of compartments. Proper training on procedures and equipment.
Use of explosives	Crushing injury, over pressurization injury.	Proper training on procedures and equipment. Use of approved blasting plan. Remove divers from water during detonation. Use of ROV for post blast assessments.
Contaminated water	Acute or chronic adverse health reactions/concerns.	Identification of toxins/contaminants. PPE. Proper training on procedures and equipment. Any diving performed in contaminated water shall be performed with a detailed contaminated water diving plan IAW *Appendix F Contaminated Water Diving Operations*

Dive Planning Risk Management Worksheet

DIVING PLANNING ORM WORKSHEET

(Sheet 1 of 3)

A. CONDUCT RISK ASSESSMENT: Operational Mission or Training?

Note: There is no such thing as operational necessity in a training environment.

1. Identify and Assess Hazards

Insert a Severity and Probability code for each applicable hazard and the resulting RAC:

Environmental Hazards:

1. Weather:	____+____=____	2. Sea State:	____+____=____
3. Surface Visibility:	____+____=____	4. Underwater Visibility:	____+____=____
5. Depth:	____+____=____	6. Bottom Type:	____+____=____
7. Tides/Currents:	____+____=____	8. Water Temp:	____+____=____
9. Contaminated Water:	____+____=____	10. Altitude:	____+____=____
11. Dangerous Marine Life:	____+____=____	12. Other:	____+____=____

Operational Hazards:

1. Fouling/Entrapment:	____+____=____	2. Enclosed Space Diving:	____+____=____
3. Electric Shock:	____+____=____	4. Explosions:	____+____=____
5. SONAR:	____+____=____	6. Nuclear Radiation:	____+____=____
7. Surface Traffic:	____+____=____	8. Equipment Failure:	____+____=____
9. Loss of Depth Control:	____+____=____	10 Other: (i.e. fatigue, experience)	____+____=____

Severity:

Category	Description
I	Loss of the ability to accomplish the mission. Death or permanent total disability. Loss of Mission-critical system or equipment. Major facility damage. Sever environmental damage. Loss of a Mission-critical security failure. Unacceptable collateral damage.
II	Significantly degraded mission capability or unit readiness. Permanenet partial disability or severe injury or illness. Extensive damage to equipment or systems. Significant damage to property or environment. Security failure. Significant collateral damage.
III	Degraded mission capability or unit readiness. Minor damage to equipment, systems, property, or the environment. Minor injury or illness.
IV	Little or no adverse impact on the mission capability or unit readiness. Minimal threat to personnel, safety, or health. Slight equipment or systems damage, but fully functional and serviceable. Little or no property or environmental damage.

Probability:

Category	Description
A	Likely to occur, immediately or within a short period of time. Expected to occur frequently to an individual item or person; or continuously over a service life for an inventory of items or group.
B	Probably will occur in time. Expected to occur several times to an individual item or person; or frequently over a service life for an inventory of items or group.
C	May occur in time. Can reasonably be expected to occur some time to an individual item or person; or several times over a service life for an inventory of items or group.
D	Unlikely to occur, but not impossible.

DIVING PLANNING ORM WORKSHEET

(Sheet 2 of 3)

2. Identify Control Options

Environmental Hazards:

1. Weather:	____________	2. Sea State:	____________
3. Surface Visibility:	____________	4. Underwater Visibility:	____________
5. Depth:	____________	6. Bottom Type:	____________
7. Tides/Currents:	____________	8. Water Temp:	____________
9. Contaminated Water:	____________	10. Altitude:	____________
7. Dangerous Marine Life:	____________	8. Other:	____________

Operational Hazards:

1. Fouling/Entrapment:	____________	2. Enclosed Space Diving:	____________
3. Electric Shock:	____________	4. Explosions:	____________
5. SONAR:	____________	6. Nuclear Radiation:	____________
7. Surface Traffic:	____________	8. Equipment Failure:	____________
9. Loss of Depth Control:	____________	10: Other:	____________

Risk Assessment Matrix				Probability			
				Frequency of Occurrence Over Time			
				A Likely	B Probable	C May	D Unlikely
SEVERITY	Effect of Hazard	I	Loss of Mission Capability, Unit Readiness or Asset; Death	1	1	2	3
		II	Significantly Degraded Mission Capability or Unit Readiness; Severe Injury or Damage	1	2	3	4
		III	Degraded Mission Capability or Unit Readiness; Minor Injury or Damage	2	3	4	5
		IV	Little or No Impact to Mission Capability or Unit Readiness; Minimal Injury or Damage	3	4	5	5

Risk Assessment Codes

1 - Critical 2 - Serious 3 - Moderate 4 - Minor 5 - Negligible

Note: It is important to remember that severity is independent of probability and reducing probability does not change mishap severity.

DIVING PLANNING ORM WORKSHEET

(Sheet 3 of 3)

3. Determine Control Effects:

Insert a mitigated probability code for each applicable hazard and the revised RAC.

Note: It is important to remember that hazard severity is independent of mishap probability. Mitigations only reduce probability and do not change the severity should a mishap occur.

Environmental:

1. Weather:	____+____=____	2. Sea State:	____+____=____
3. Surface Visibility:	____+____=____	4. Underwater Visibility:	____+____=____
5. Depth:	____+____=____	6. Bottom Type:	____+____=____
7. Tides/Currents:	____+____=____	8. Water Temp:	____+____=____
9. Contaminated Water:	____+____=____	10. Altitude:	____+____=____
7. Dangerous Marine Life:	____+____=____	8. Other:	____+____=____

Operational:

1. Fouling/Entrapment:	____+____=____	2. Enclosed Space Diving:	____+____=____
3. Electric Shock:	____+____=____	4. Explosions:	____+____=____
5. SONAR:	____+____=____	6. Nuclear Radiation:	____+____=____
7. Surface Traffic:	____+____=____	8. Equipment Failure:	____+____=____
9. Loss of Depth Control:	____+____=____	10: Other:	____+____=____

Residual Risk by COA.: List hazards with moderate and above residual risk for each COA:

COA 1: ______________________ ______________________ ______________________

COA 2: ______________________ ______________________ ______________________

COA 3: ______________________ ______________________ ______________________

Risk of each COA: Critical (1), Serious(2), Moderate(3), Minor(4), or Negligible(5):

COA 1: ______________

COA 2: ______________

COA 3: ______________

COA Decision:

Diving Supervisor (Print)______________________________ Sign:_____________________________

Higher Approval (as Required):___________________________/_______________________________

Higher Approval (as Required):___________________________/_______________________________

Higher Approval (as Required):___________________________/_______________________________

SAMPLE: Activity HAZARD ANALYSIS Format

Activity Hazard Analysis (AHA)

Activity/Work Task:	Overall Risk Assessment Code (RAC) (Use highest code)					
Project Location:	**Risk Assessment Code (RAC) Matrix**					
Contract Number:	**Severity**	**Probability**				
Date Prepared:		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title):	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title):	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)	
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**
		H = High Risk
	Step 2: Identify the RAC (Probability/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

Job Steps	**Hazards**	**Controls**	**RAC**
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**	

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Appendix B: Dive Briefs and Logs

Emergency Assistance Checklist

<u>EMERGENCY MEDICAL SERVICE (EMS)</u> Location: Phone Number: Remarks:	<u>RECOMPRESSION CHAMBER</u> Location: Phone Number: Remarks:
<u>DIVING MEDICAL OFFICER</u> Location: Name: Phone Number: Response Time:	<u>LAW ENFORCEMENT:</u> Location: Phone Number: Remarks:
<u>FIRE DEPARTMENT</u> Location: Phone Number: Remarks:	<u>EMERGENCY CONSULTATION</u> Divers Alert Network 919-684-9111 Navy Experimental Dive Unit (NEDU) Phone Numbers 24 Hours a Day (850) 234-4351 (850) 230-3100

SUPERVISOR________________________________ **DATE**________________

AOR International
Dive Brief

CHECK THE SIDE

DIVE SUPERVISORS CHECKLIST COMPLETE _______ LOADLIST COMPLETED _________

CALL SIGN ____

ROLL CALL
ASSUME THE SIDE

1. PM _______________ QC/Safety _________________ Field Sup _________________ DDC__________________

DIVE BILL

2. OPERATION IN DETAIL/TIME LINE____
____

ANTICIPATED CONDITIONS

WEATHER _____________ AIR TEMP _____ WIND DIRECTION/SPEED _____/_____ SUN RISE/SET_____/_____

WAVE HEIGHT ______ CURRENT DIRECTION/SPEED _____/_____ VIS SURFACE/BOTTOM _____/______

OCEAN TEMP________ BOTTOM TYPE____________ BOTTOM HAZARDS______________________________

SHORE TYPE______________________ ONSITE/MISSION HAZARDS ______________________________

DEPTH/BT _____/_____ NO D LIMITS ____/_____ NTE ____/____ NTE NO D LIMITS _____/_____

BRIEF EMERGENCY MISHAP PLAN

PRIMARY RECOMPRESSION CHAMBER

LOCATION __________________ TRANSIT TIME__________ RESPONSE TEAM # _______________________

TRANSPORTATION/EVACUATION TO MEDICAL FACILITY POV/TRUCK/SMALL CRAFT
CONTACTS FOR TRANSPORTATION ____

ROUTE TO MEDICAL FACILITY ____

ISOLATE GEAR ON DIVE STATION ____

COMMUNICATIONS __________________________ SAFETY DRIVER ________________________________

BRIEF DIVE TEAM

DIVERS – ANY PROBLEMS MAKING THIS DIVE, LAST TIME IN RIG, LINE PULLS, HAND SIGNALS, EP's FOR THE RIG, GO ON RESERVE/TERMINATE DIVE, (500 psi SINGLE/250 psi TWINS) STAY TOGETHER, ABORT DIVE IF

CONDITIONS CHANGE OR YOU EXPERIENCE ANY ADVERSE PHYSIOLOGICAL SYMPTOMS OR RIG MALFUNCTIONS, DIVERS FULLY UNDERSTAND OPERATION. ANY QUESTIONS?
ALL DIVERS CLEAR OK/CLEAR NOW, ANY DIVES LAST 12 HOURS, ANY MEDICATIONS, FALSE TEETH, CONTACTS, ACHES, PAINS, WEAKNESS, ANY NEUROLOGICAL DEFICIETS, I SHOULD KNOW ABOUT.

"NOTE HOW YOU FEEL RIGHT NOW, IF YOU FEEL ANY DIFFERENT FROM THE TIME YOU LS TO RS LET ME KNOW. ASAP"

STANDBY DIVER – DRESS OUT (OCTOPUS RIG), DOWN DRESS AT MY DISCRETION, STAY ALERT, I WILL BRIEF YOU FULLY BEFORE DEPLOYING, ASSESS SITUATION, EYES ON THE BOTTOM, LET ME KNOW HOW I CAN HELP, FOLLOW EP's. ANY QUESTIONS?

TENDERS – ASSIST DRESSING DIVERS, CHECK RED/GREEN/STANDBY, MAINTAIN POSITIVE CONTROL AT ALL TIMES, IF SURFACE TENDED FISH THE DIVERS, REPORT ALL LINE PULLS, TRACK BUBBLES, WITNESS FLOAT, WATCH FOR BOAT TRAFFIC, STAY ALERT. ANY QUESTIONS?

DIVE PROCEDURES

EXPLAIN IN DETAIL

WATER ENTRY ______________________________ WATER EXIT ___________________________________

DESCENT – NTE 75 fpm, STAY AHEAD OF THE PRESSURE, SQUEEZE HALT DESCENT ASCEND TIL DOR, CLEAR AND CONTINUE DESCENT, DON'T PUSH IT.

ASCENT – NTE 30 fpm, BREATHE NORMAL, HAND OVER HEAD, 360 SWEEP DURING ASCENT CHECKING FOR SMALL CRAFT, ON SURFACE REPORT OK MAX DEPTH/BT.

RECALL DEVICES – PRIMARY – COMMS, TENDING LINE, 4 REVS/RAPS, STICKS
(CIRCLE ONE) SECONDARY – TENDING LINE, STDBY, 4 REVS/RAPS, STICKS

EMERGENCY PROCEDURES

LOST/SEPARTED DIVER – 360 SWEEP, LOOK FOR BUBBLES, TAP ON TANKS, SLOWLY ASCEND, SURFACE REPORT TO SUP (OK MAX DEPTH/BT/psi), MARK SPOT, INITIATE RECALL, DEPLOY LOST DIVER BOUY, and CONDUCT CIRCLE SEARCH.

FOULED/TRAPPED DIVER – REMAIN CALM EVALUTE SITUATION, UNFOUL/CUT YOURSELF FREE - BUDDY DIVER ASSIST FOULED/TRAPPED DIVER, (CHECK EGS AIR SUPPLY), ATTACH TENDING LINE/WITNESS FLOAT, SURFACE IF ASSISTANCE IS NEEDED FROM TOPSIDE. LINE PULLS (2-2-2 I NEED U, 3-3-3 I WILL BE FREE)

LOSS OF AIR – TURN ON EGS AT SIDE BLOCK, SIGNAL BUDDY/LEAD DIVER, BUDDY BREATHE, ABORT DIVE MAKE A CONTROLLED ASCENT. DITCH GEAR AS LAST RESORT, BLOW AND GO.

INJURED/ UNCONSCIOUS – GET POSITIVE CONTROL OF DIVER, DITCH WEIGHT BELT, PRESSING ON DIAPHRAM, CHECK VITALS, INFORM SUPERVISOR.
NO VITALS COMMENCE RESCUE BREATHING, 2 QUICK BREATHS/1 EVERY 5 SECONDS TILL DIVER IS ON PLATFORM, COMMENCE CPR.

EXTRACTION BRIEF – MAINTAIN POSITIVE CONTROL OF DIVER, STRIP/ISOLATE GEAR, CHECK ABC's ON DECK, ADMINISTOR O2, INITIATE EMERGENCY MEDICAL PLAN, TRANSPORT.

DIVING RELATED DISORDERS/DISEASES

TYPE I – PISS/PMS
TYPE II – (PARALYSIS/WEAKNESS, NUMBNESS/TINGLING, MENTAL STATUS, COORDINATION, NAUSEA, CONVULSIONS ETC.)
POIS – **AGE** - SAME SYMPTOMS AS TYPE II TIME ONSET IS THE KEY.
PNEUMO – (SHARP PAIN, SHORTNESS OF BREATH, RAPID BREATHING)
MEDIASTINAL - (MILD/MOD PAIN BREASTBONE, DULL ACHE, WORSE DEEP INSPIRATION, RADIATE TO NECK, BACK, SHOULDER)
SUBCUTANEOUS - (FULLNESS AROUND NECK, DIFFICULTY SWALLOWING, VOICE CHANGE, RICE CRISPIES)
SQUEEZES – MIDDLE EAR/SINUS (PAIN, DIZZINESS, VERTIGO, NAUSEA) REVERSE SQUEEZE - ASCENT (PAIN ABV)
CO POISONING – (HEAD ACHE MILD/SEVERE, NAUSEA, MENTAL CONFUSION, TIGHTNESS ACROSS FOREHEAD)
CO2 TOXICITY – (SHORTNESS OF BREATH, MENTAL CONFUSION, RAPID PULSE, HEADACHE, DIZZINESS, ETC.)

ANY QUESTIONS, COMMENTS, PROBLEMS, UNDERSTAND OPERATION.

LOAD UP/UNDERWAY, DRESS DIVERS, STAND BY FOR PRE-DIVE CHECKS

Dive Supervisor (Print / Sign):	Date:

Rough Diving Log

ROUGH DIVE LOG

NAME:	L/S	L/B	BT	MAX DEPTH	SI	RNT

Dive Supervisor________________________ **Date of Dive:**________________

DIVE LOG

Dive Date: ____________ Company: AOR International LLC Location: ____________

Equipment

Platform: ____________ Gas Source: Air Apparatus: ____________ Dress: ____________

Environment

Dive Location: ____________ Altitude: ____________
Air Temp: ____________ Water Temp: ____________
Current: ____________ Wave Ht. ____________
Visibility: ____________ Bottom Type: ____________

Dive Data

Diver	LS	BT	LB	TDT	RS	TTD	Depth	T/S	SI	RNT	NOTES
Hatcher	9:05	0:12	9:17	0:01	9:18	0:13:00	53'	53/12			Example

Dive Description

Purpose: ____________

Description: ____________

Dive Supervisor: ____________ Date: ____________

Chamber Log

Chamber Log

Date:

Purpose:

Supervisor: Inside tender(s):

Comms/Logs: Outside tender:

Time	Depth	Lock	Event	Narrative

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Appendix C – SSA Diving Checklists

Dive Site Checklist

Pre-Dive			
	Planning		**On Station Items**
	NOAA Weather Forecast		Dive Brief
	Small Boat Advisory (Yes or No)		SPM (approved and signed)
	Sea State (0 – 9) ________		Diver Certification Docs
	Wind Speed ________		Dive Plan (approved and signed)
	Current ______kts		EMP
	Water Temp ______		AHA's (approved and signed)
	OP's in the area (i.e. boat traffic, sonar)		Dive Manual / Logs / Charts
	Manning Level, IAW EM 385-1-1		OP's / EP's (System and Chamber)
	Dive Coordinator Notified		Missions and Pre-Dives
	Chamber Notified		Supervisor Checklist
	Dive Manifest / Sailing List Posted		Cell Phone / Radio (marine band/VHF)
	O_2 Requirements ___________ SCFT		
	Air Requirements ___________ SCFT		

Station Checks			
	Code Alpha / Day Shapes		Diver Ready / Knives / Shackle
	Lights / Tools for the job		Standby EGS (most PSI)
	Side Clean / Organized		Communication Power Supply
	Mooring Reference Point		Air Lined Up to Divers
	Ladder secured and stable		Metal Detector / Batteries
	O_2 / First Aid Kit ____________psi		Stretcher / Head Support / Straps
	Extraction Line		AED on Station (Green light)
	ACLS travel time____________		Fuel (boat, generator, etc.)
	Life Jackets (all personnel)		Leak Test (Snoop)
	Sanizide and Fresh Water Rinse		Boat USCG Approved

Dive Supervisor (Print / Sign):	Date:

Full Face Mask (FFM) Supervisor Pre-Entry Check sheets

Date: ____________________ Job: ____

Helmet Type	Serial No.	Checked By:	Supervisor Name	Supervisor Signature
1.				
2.				

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the FFM.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Dive Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Pre-missions / pre-dives complete**			
2	**Don thermal protection: (if needed)**			
3	**Don harness and weights / pull test fins**			
4	**Connect umbilical shackle: (left side) Tuck pneumo.**			
5	**Send air to the hats**			
6	**Tenders do surface checks on the hats**			
7	**Record Air Bank Pressure 1.____________________ 2.__________________**			
8	**Record Minimum Manifold Pressure. (115psig minimum) PSIG ________________**			
9	**Open EGS and record pressure**			
10	**Ensure valve is secured at side block**			
11	**Purge and test pneumo (1st Dive ONLY)**			
12	**Don mask and activate air flow**			
13	**Verify rig breaths fine**			
14	**Check comms (round robin)**			
15	**Leak test back to console (1st dive ONLY)**			
16	**Physically check divers and rig (check knobs and screws)**			
17	**Have Standby diver remove mask once divers are on the bottom.**			

Pre-Dive: AGA / Guardian Checkoff Sheet

Date: ____________________ Job: ______________________________________

Diver 1/ Tender 1:_________________________/__________________________

Diver 2/ Tender 2:_________________________/__________________________

Mask Type	Serial No.	Checked By:	Checked By Signature	Supervisor Signature
1.				
2.				

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the AGA to be pre-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Visually inspect the rubber for signs of damage. Visually inspect face plate to be secure and undamaged.**			
2	**Check the screws that hold the comm port cover are hand tight. Do not over tighten.**			
3	**Inspect the oral nasal for cracks or other defects.**			
4	**Inspect the Spider to ensure there are no tears and/or cracks in the material. Ensure all five legs are present. If it is worn and/or cracked, it must be replaced.**			
5	**Ensure the Earphones and the Microphone are installed correctly.**			
6	**Ensure the One-Way Valve is operational** **WARNING: The One-Way Valve must be tested daily prior to commencing diving operations.**			
7	**Inspect the hoses attached to the block assembly and check valve**			
8	**Connect the First Stage Regulator to the EGS Cylinder and the Mask Emergency Supply Valve. With the Cylinder turned OFF, open and close the Side Block Auxiliary Valve (EGS) to check for smooth operation. Then depress purge button on FFM.**			
9	**Visually inspect all EGS hoses for signs of damage.**			
10	**Check to ensure the cylinder is within the VIP and the hydro dates.**			
11	**Ensure the First Stage Regulator pressure setting and the Over Pressure Bleed/Relief Valve settings have been checked within the past month. (Maintenance Log).**			
12	**Inspect the Safety Harness and Cylinder Retainer for wear and damage. Repair/replace as necessary.**			
13	**Open the EGS Supply Valve on the cylinder. Then open the Emergency Supply Valve on the Side Block.**			

14	**Momentarily depress the purge button on the FFM. Check for a strong flow of gas, then secure.**			
15	**Blow down the Umbilical and attach it to the Umbilical Adapter on the One-Way Valve.**			
16	**Depress the Purge Button all the way, verify a strong surge of gas.**			
17	**Ensure the Side Block Emergency Valve is closed, and the Bail Out Cylinder Valve is open. Log the cylinder pressure psig.**			**1. PSIG _____________** **2. PSIG _____________**
18	**Perform communications check.**			
19	**Soap and leak check the Mask gas fittings and connections including the EGS.**			
20	**Check Diver’s Safety Harness**			
21	**Check Umbilical Strain Release**			
22	**Check EGS Hose Quick Disconnect**			
23	**Check to ensure the Mask is breathing easily**			

POST-DIVE: AGA / Guardian FFM CHECKOFF SHEET

Date: ____________________ **Job:** ______________________________________

Helmet Type	Serial No.	Checked By:	Check By Signature	Supervisor Signature
1.				
2.				

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the FFM to be post-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	Secure and bleed down gas supplies.			
2	Disconnect and cap air connections and disconnect the communication wires.			
3	Immerse the face mask and the breathing valve into Sanizide solution, then rinse with fresh water. Inspect for signs of damage.			
4	Press the purge button and allow the air to flow through the valve until the valve is dry.			
Perform the following after prolonged use or diving in dirty water				
5	Remove Mic cover by unscrewing the two screws and pulling the cover off.			
6	Turn the breathing valve clock-wise so that it comes away from the bayonet coupling and pull the valve outwards.			
7	Unscrew the locking ring and remove the positive pressure unit from the valve housing.			
8	Hold the positive pressure unit and loosen the diaphragm assembly by squeezing the thread of the cover. Separate the components carefully.			
9	Remove the positive pressure spring and the guide disc from the positive pressure unit cover.			
10	Remove the sealing disc and the exhalation diaphragm from the diaphragm assembly. Do not dismantle the diaphragm assembly any further.			
11	Wash parts with soap and warm water, then rinse in clean water.			
12	Let parts dry before assembly			

KMB-18B Supervisor Pre-Entry Dive Check sheet

Date: ____________________ Job: ______________________________________

Diver 1/ Tender 1:_________________________/__________________________

Diver 2/ Tender 2:_________________________/__________________________

Mask Type	Serial No.	Checked By:	Check By Signature	Supervisor Signature
1.				
2.				

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Band Mask be post dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	Open and close Steady Flow Valve to ensure proper operation.			
2	Check breathing resistance, adjust Demand Regulator Adjustment Knob for minimum inhalation effort.			
3	Press Purge Button to check gas purge function.			
4	Ensure Nose Block Device slides freely.			
5	Ensure Emergency Valve opens and closes properly, then verify Emergency Valve is shut and the Bail Out Cylinder Valve is open.			
6	Perform communications check.			
7	Soap and leak check the Mask gas fittings and connections, including the EGS.			
8	Diver's Safety Harness			
9	Umbilical Strain Release			
10	EGS Hose Quick Disconnect			
11	Boots or fins, gloves, knife, and other accessories			
12	Helmet supply pressure, minimum 115 psig.			
13	Check to ensure helmet is breathing easily.			

Pre-Dive: KMB 18 (Band Mask) Checkoff Sheet

Date: ____________________ Job: ______________________________________

Diver 1/ Tender 1:_________________________/_________________________

Diver 2/ Tender 2:_________________________/_________________________

Mask Type	Serial No.	Checked By:	Signature	Supervisor Signature

Note: All items will be checked in appropriate blocks as follows:
1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Dive Helmet be pre-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Visually inspect the Hood and Face Seal for signs of damage. Check the Hood for tears, holes, and/or cuts. Ensure the Face Seal is properly glued to the Hood.**			
2	**Check the screws that hold the Bands in position. They must be properly torque to *26-inch pounds (28 kg cm)***			
3	**Inspect the Bands. Ensure the welds exhibit no signs of cracking and/or parting. Inspect all band keeper components**			
4	**Inspect the Spider to ensure there are no tears and/or cracks in the material. Ensure all five legs are present. If it is worn and/or cracked, it must be replaced.**			
5	**Visually inspect the interior/exterior of the Band Mask for any obvious signs of damage. Check to make sure the Oral Nasal Valve is correctly installed and the Oral Nasal Mask is installed on the Regulator Mount Nut. Ensure the Nose Clearing Device operates smoothly. Lubricate as necessary. Guidance O & M Manual.**			
6	**Ensure the Earphones and the Microphone are installed correctly. Check the Wire Lugs to ensure they are not touching each other. Guidance O & M Manual.**			
7	**Ensure the Demand Regulator Cover is not excessively dented, with dents deeper than ¼ inch.**			
8	**Inspect the Regulator Hose Assembly on the KMB-18A. The Hose(s) and fittings must be in good shape. On the KMB-18B, the Bent Tube must not have any dents and/or compressed areas exceeding 1/8”**			
9	**Check all moving parts to ensure smooth and proper operation. 1) Defogger Control Knob 2) Auxiliary Knob (EGS) 3) Nose Block Device 4) Regulator Adjustment Knob**			

10	**Ensure the One-Way Valve is operational** **WARNING: The One-Way Valve must be tested daily prior to commencing diving operations.**			
11	**Connect the First Stage Regulator to the EGS Cylinder and the Mask Emergency Supply Valve. With the Cylinder turned OFF, open and close the Side Block Auxiliary Valve (EGS) to check for smooth operation. Then open and close the Defogger Valve to check for smooth operation.**			
12	**Visually inspect all EGS hoses for signs of damage.**			
13	**Check to ensure the cylinder is within the VIP and the hydro dates.**			
14	**Ensure the First Stage Regulator pressure setting and the Over Pressure Bleed/Relief Valve settings have been checked within the past month. (Maintenance Log).**			
15	**Inspect the Safety Harness and Cylinder Retainer for wear and damage. Repair/replace as necessary.**			
16	**Document inspection/maintenance in Maintenance Log**			
17	**Rotate the Regulator Adjustment Knob in fully (clockwise), then rotate out (counterclockwise) 3 – 4 rotations to check for smooth operation.**			
18	**Open the EGS Supply Valve on the cylinder. Log the pressure. Then open the Emergency Supply Valve on the Side Block.**			**1. PSIG ________** **2. PSIG ________**
19	**Momentarily open the Mask Defogger ¾ to 1 full turn. Check for a strong flow of gas out of the Defogging Train, and then close.**			
20	**Check for gas escaping from the One-Way Valve.**			
21	**Blow down the Umbilical and attach it to the Umbilical Adapter on the One-Way Valve.**			
22	**Rotate out (counterclockwise) on the Demand Regulator Adjustment Knob until a slight free flow develops. Then rotate in (clockwise) until the free flow stops.**			
23	**For masks equipped with a SuperFlow or SuperFlow 350 regulator, slowly depress the purge button to check for excessive travel. The purge button should travel in no less that 1/16” and out no more than 1/8” before gas flow is heard. For masks equipped with a 450 or 455 balanced regulator depressing the flexible cover the cover should travel 1/16” to 1/8” before gas starts to flow.**			
24	**Depress the Purge Button all the way, verify a surge of gas. Pressing the flexible cover of the 450 and 455 further than 1/4" should result in a strong flow of gas.**			

25	**Ensure the Side Block Emergency Valve is closed, and the Bail Out Cylinder Valve is open. Log the cylinder pressure psig.**			**1. PSIG _______** **2. PSIG ________**
26	**Perform communications check.**			
27	**Soap and leak check the Mask gas fittings and connections including the EGS.**			
28	**Check Diver's Safety Harness**			
29	**Check Umbilical Strain Release**			
30	**Check EGS Hose Quick Disconnect**			
31	**Check to ensure the Mask is breathing easily**			

Post Dive: KMB 18 (Band Mask) Checkoff Sheet

Date: ____________________ Job: ______________________________________

Diver 1/ Tender 1:_________________________/_________________________

Diver 2/ Tender 2:_________________________/_________________________

Mask Type	Serial No.	Checked By:	Check By Signature	Supervisor Signature
1.				
2.				

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Band Mask be post dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Secure and bleed down gas supplies.**			
2	**Disconnect and cap the Mask Gas Connections and disconnect the communication wires. Cap the Umbilical End.**			
3	**Wash the exterior surface of the Mask with a solution of mild detergent and fresh water, then rinse. Inspect for signs of damage.**			
4	**Dislodge the Earphones from their pockets in the Hood. Remove the Earphone protective covers, clean and rinse to allow to dry.**			
5	**Clean Hood Assembly. Rinse with fresh water and inspect for damage. Hang-up for drying or airing.**			
6	**Remove the Demand Regulator Clamp, Cover, and Diaphragm Assembly. Wash the interior of the Demand Regulator with mild detergent and fresh water, then rinse thoroughly.**			
7	**Remove the Microphone from the Oral Nasal Mask. Avoid getting water on the Oral Nasal Mask, Microphone and Earphones.**			
8	**Wipe down interior of the Mask, including the Oral Nasal Mask with Sanizide and fresh water solution. Thoroughly rinse with fresh water while cycling the Defogger Knob, Auxiliary Gas Knob (EGS) and Regulator Adjustment Knob.**			
9	**Fully back out on the Regulator Adjustment Knob, counterclockwise (this will prolong the life of the Inlet Valve Seat). Shut the Auxiliary Supply (EGS) and Steady Flow Valves.**			
10	**Wipe all surfaces with a clean dry towel to remove water droplets. Allow to air dry.**			
11	**Cap the Emergency Gas Whip on the First Stage Regulator. Wash the exterior of all EGS components, the First Stage Regulator, the Gas Cylinder, the submersible pressure gauge, and the Harness Assembly with a mild detergent solution and rinse with fresh water. Hang-up Harness Assembly for drying or airing.**			

KM-37 Supervisor Pre-entry Check sheets

Date: ____________________ **Job:** ______________________________________

Helmet Type	Serial No.	Checked By:	Signature	Supervisor Signature

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Dive Helmet be pre-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Ensure gas to the diver**			
2	**Log the EGS cylinder pressure**			**1. PSIG____________** **2. PSIG____________**
3	**Divers open and close the Steady-Flow Valve to ensure proper operation.**			
4	**Divers check breathing resistance. Set Demand Regulator Adjustment Knob for minimum inhalation effort**			
5	**Divers press Purge Button to check gas purge function.**			
6	**Divers ensure Nose Block Device slides freely.**			
7	**Divers ensure Emergency Valve opens and closes properly. Then, ensure Emergency Valve is closed and the Bail Out Cylinder Valve is open.**			
8	**Perform communications check.**			
9	**Soap and leak check Helmet/Mask gas fittings and connections, including Emergency Gas System.**			
10	**Ensure the sealed Pull Pins are fully engaged on the base of the Helmet Ring into the Locking Collar/Neck Pad Assembly.**			**Attempt to rotate pull pins, if pin rotates this is an indication that pin is not correctly engaged**
11	**Check the Diver's Safety Harness.**			
12	**Check the Umbilical strain release.**			
13	**Check the EGS Hose Quick Disconnect**			
14	**Check boots, gloves, knife, and other accessories**			
15	**Helmet supply pressure, minimum 115 psig (7.93 bar).**			
16	**Diver ensure helmet is breathing properly**			

PRE-DIVE: DEMAND DIVE HELMET CHECKOFF SHEET

Date: ____________________ Job: ______________________________________

Diver 1/ Tender 1:_________________________/__________________________

Diver 2/ Tender 2:_________________________/__________________________

Helmet Type	Serial No.	Checked By:	Signature	Supervisor Signature

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Dive Helmet be pre-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Visually inspect the Neck Dam Ring Assembly for signs of damage. Check the Neck for tears, holes, and/or cuts. Ensure the Neck Dam is of the proper size and fit.**			
2	**Test-mate the Neck Dam Ring Assembly to the Helmet and check for proper adjustment.**			
3	**Ensure the sealed Pull Pins work properly.**			
4	**Visually inspect Helmet Shell interior and exterior for damage and/or contamination. Check that the Oral Nasal Valve is correctly installed and the Oral Nasal Mask is installed on the Regulator Mount Nut. Ensure the Nose Clearing Device operates smoothly. Lubricate as necessary.**			
5	**Ensure the Earphones and Microphones are installed correctly.**			
6	**Inspect the Head Cushion for proper fit, broken snaps, tears, and/or rips. Lightly lubricate male snaps with silicone 111.**			
7	**Visually inspect all EGS Hoses for signs of damage.**			
8	**Check the hydro date and ensure the cylinder is within the VIP and the hydrostatic date. Visually inspect the cylinder and valve for obvious signs of damage.**			
9	**Ensure the First Stage Regulator pressure and the Over-Pressure Bleed/Relief Valve settings have been checked within the past month.**			
10	**Inspect the Safety Harness and Cylinder Retainer for wear and/or damage. Repair/replace as necessary.**			
11	**Orally check the One-Way Valve. (blow and suck)**			
12	**Connect the First Stage Regulator to the EGS Cylinder and the Helmet Emergency Supply Valve. With the cylinder turned OFF, open and close the Side Block Emergency Valve to check for smooth operation. Then open and close the Steady flow.**			

13	**Rotate the Regulator Adjustment Knob in fully (clockwise), then rotate out (counterclockwise) 3 – 4 rotations to check for smooth operation.**			
14	**Open the EGS Supply Valve on the cylinder. Next open the Emergency Supply Valve on the Side Block.**			
15	**Momentarily open the Helmet Steady Flow 3/4 to 1 full turn. Check for a strong flow of gas out of the Defogging Train, and then close.**			
16	**Check for gas escaping from the One-Way Valve.**			
17	**Adjust dial-a-breath**			
18	**Check free-flow**			
19	**Check purge**			
20	**Ensure the Side Block Emergency Valve is shut and the Bail Out Cylinder Valve is open.** **PSIG ________________ PSIG________________**			
21	**Connect Umbilical to air source. Blow down umbilical then attach to side block one-way valve.**			
22	**Connect communications. Perform communications check.**			
23	**Leak check all gas fittings and EGS connections.**			

POST-DIVE: DEMAND DIVE HELMET CHECKOFF SHEET

Date: ____________________ Job: ______________________________________

Helmet Type	Serial No.	Checked By:	Signature	Supervisor Signature

Note: All items will be checked in appropriate blocks as follows:

1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the Dive Helmet be pre-dove.
3. When complete, person completing the checks will sign as appropriate (blocks 1 or 2) and then return to Diving Supervisor for final review and check.

Task	Procedures	1	2	Remarks
1	**Secure and bleed down gas supplies.**			
2	**Disconnect and cap or tape the Helmet Gas Connections and disconnect the communication wires. Cap or tape the Umbilical End.**			
3	**Wash the exterior surface of the Helmet with a solution of mild detergent and fresh water, then rinse. Inspect for signs of damage.**			
4	**Remove the Head Cushion Assembly. Inspect for damage. If the Head Cushion has gotten wet with perspiration or water, clean and hang-up for drying or airing.**			
5	**Remove the Demand Regulator Clamp, Cover, and Diaphragm Assembly. Wash the interior of the Demand Regulator with mild detergent and fresh water, then rinse thoroughly.**			
6	**Dislodge the earphones. If the interior of the Helmet and Liner has gotten wet, remove the earphone protective covers, wash with mild detergent solution, rinse with fresh water and allow to dry.**			
7	**Remove the microphone from the Oral Nasal Mask. Wash with a mild detergent solution and rinse with fresh water.**			
8	**Wipe interior of the Helmet, including the Oral Nasal Mask. Wash with Sanizide and rinse with fresh water.**			
9	**Rotate the Regulator Adjustment Knob fully out (counter clockwise). Close the Emergency Supply and Steady Flow Valves.**			
10	**Clean the Neck Ring, and Pull Pin Assemblies with mild detergent solution, thoroughly rinse with fresh water.**			
11	**Wipe all surfaces with a clean, dry towel to remove water droplets. Allow to air dry.**			
12	**Cap the Emergency Gas Whip on the First Stage Regulator. Wash the exterior of all EGS components, with a mild detergent solution and rinse with fresh water.**			
13	**Note any damage or discrepancies found during cleaning.**			

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Appendix D – SCUBA Diving Checklists (with or without FFM)

SCUBA Dive Site Checklist

Pre-Dive			
Planning		**On Station Items**	
	NOAA Weather Forecast		Dive Brief
*	Small Boat Advisory (Yes or No)		SPM (approved and signed)
*	Sea State (0 – 9) ________		Diver Certification Docs
	Wind Speed ________		Dive Plan (approved and signed)
	Current ______kts		Emergency Management Plan
	Water Temp ______		AHA's (approved and signed)
	OP's in the area (i.e. boat traffic, sonar)		Dive Manual / Logs / Charts
	Manning Level, IAW EM 385-1-1	*	OP's / EP's (Chamber, as required)
	Dive Coordinator Notified		Maintenance and Pre-Dives
	Chamber Notified		Supervisor Checklist
	Dive Manifest / Sailing List Posted		Cell Phone / Radio (marine band/VHF)
	O_2 Requirements ___________ SCFT	*	Pre missions conducted on Full Face Mask (as Required)
	Air available for depth_______ SCFT		

Station Checks			
	Code Alpha / Day Shapes		Recall device
	Lights / Tools for the job		Standby (most PSI)
	Tending lines / buddy line		Comms Power Supply (as required)
*	Mooring Reference Point		Proper diver protection
*	Ladder secured and stable		Metal Detector / Batteries
	O_2 / First Aid Kit ____________psi		Stretcher / Head Support / Straps
*	Extraction Line		AED on Station (Green light)
	ACLS travel time____________	*	Fuel (boat, generator, etc.)
	Life Jackets (all personnel)		Leak Test (Snoop)
	Sanizide and Fresh Water Rinse	*	Boat USCG Approved

* Blocks may not be required on some dives

Dive Supervisor (Print / Sign):	Date:

SCUBA Supervisor Pre-Entry Check sheets
(with or without FFM)

Date: ____________________ **Job:** ____

Note: All items will be checked in appropriate blocks as follows:
1. Initial for each completed and satisfactory check.
2. An N/A for each item not applicable to the FFM.
3. When complete, Dive Supervisor will sign and date appropriate blocks

Task	Procedures	DV 1	DV 2	STBY
1	MINIMUM EQUIPMENT: 1. Tanks / Regulator / Pressure Gauge 2. Buoyancy compensator 3. Depth gauge / watch (or dive computer) 4. Mask, fins, knife 5. Weights (as required) 6. Proper thermal protection			
2	Fully open cylinder valve (back a ¼ turn)			
3	Cycle reserve, leave in up position			
4	Cylinder pressures / max time at depth________			
5	Quick releases / buckles properly rigged			
6	Check BC: Not Constrained / manual inflator / power inflator / dump valves			
7	Weights properly installed / belt outside of all equipment			
8	* Lifeline attached / buddy line ready (as required)			
9	Ensure knife cannot be jettisoned			
10	Tuck pressured gauge			
11	Zero depth gauge / set watch to zero			
12	Purge and breath all regulators / Secure octopus			
13	* Don FFM / adjust: nose clear device; bands (as required)			
14	* Check communications (as required)			
15	Physically check divers			
16	Sign:	Date:		

* Blocks may not be required on some dives

Appendix E –Emergency Procedures

EMERGENCY PROCEDURES (EP's)

1. Fire

a. Extinguish fire; secure equipment.
b. Determine damage and effect on Diver.
c. If required, terminate dive; commence decompression.
d. Each chamber must have a means of extinguishing a fire in the interior.

2. Equipment failure

a. Evaluate effect on Diver and dive team
b. Inform Diver of problem and action planned.
c. Alert Standby Diver, prepare to deploy.
d. Alert deck crew.
e. Diver informs topside of his readiness.
f. Activate plan, and if necessary, terminate dive.

3. Adverse weather

Warning: Lightning is cause for termination of the dive and diving will not be resumed for 30 minutes post last sighting.

If adverse weather arises:

a. Evaluate effect on the diver and dive team
b. Inform Diver of problem and action planned.
c. Alert Standby Diver.
d. Alert deck crew.
e. Diver informs topside of his readiness.
f. Activate plan, and if necessary, terminate dive.

4. Medical illness/injury of crew member

a. Initiate emergency response and evacuation as required.
b. Inform the diver of the situation and abort the dive.
c. Evaluate the effect of loss of personnel on the dive.
d. The dive may continue if there was no loss to critical surface support
e. Resume diving after diving supervisor reevaluates the impact to the dive team and proper notifications to PM and others as required.

5. Decompression Sickness without a Chamber on Site

a. Perform Rapid Neurological Exam Check on the diver and record results.
b. Contact local hyperbaric facility or hospital with hyperbaric facility noted in Emergency Action Plan.
c. Patient should be transported on back with legs slightly elevated and administered O_2.
d. The record of dive (dive sheet) and the diving supervisor shall accompany the patient to the medical facility.
e. Contact the Diving Operations Manager and C/H&S Manager as soon as possible.

6. Oxygen Toxicity in Water

a. Supervisor notes signs, or diver reports symptoms to Dive Control;
b. Immediately deploy the standby diver to assist and report on diver condition;
c. If CNS symptoms are present, do not attempt to ascend the diver until symptoms subside and it is

verified that the diver is breathing.

d. Ascend 10 FSW and reduce oxygen partial pressure (switch to air).
e. Add missed time to this next stop while breathing air.
f. Upon arrival at next shallower stop, return diver to the decompression gas.
g. Continue decompression according to procedure.
h. Contact the Manager of Diving Operations and EHS Manager for further direction.

7. Oxygen Toxicity in the Decompression Chamber

a. If possible, the diver reports symptoms to the chamber operator or the chamber operator notes signs.
b. Symptoms and signs are noted and logged by chamber operator.
c. Instruct the diver to remove oxygen mask, secure oxygen, and vent chamber.
d. Lock in a qualified tender to assist.
e. Wait 15 minutes after symptoms subside, and then continue decompression at point stopped.
f. If symptoms reoccur, repeat step e**.**

8. Severance of Diver's umbilical (Breathing Hose Only)

a. Put breathing media to diver's pneumofathometer hose.
b. Diver activates bail-out bottle.
c. Alert and prepare standby diver, prepare to deploy.
d. If required, diver inserts pneumofathometer hose inside helmet under the neck dam.
e. Diver returns to down line or stage.
f. Diver activates and uses emergency breathing supply on stage, if applicable.
g. If required, deploy the standby diver to assist.
h. Terminate dive and follow proper decompression procedures.

9. Severance of Complete Umbilical

a. Diver activates bail-out bottle and immediately deploy standby diver.
b. Diver returns to down line.
c. Diver activates and uses emergency breathing supply on stage, if applicable.
d. If umbilical is severed on deck and the end of the umbilical is still on deck, send standby diver down umbilical with hose/bail-out bottle. Otherwise, send standby diver down the down line or stage cable.
e. Terminate dive and follow proper decompression procedure.

10. Fouling and Entrapment.

a. The first and most important action that a trapped diver can take is to stop and think.
b. Inform topside of the situation
c. The diver shall remain calm, analyze the situation, and carefully try to 2C-12 U.S. Navy Diving Manual — Volume 2 work free. Panic and overexertion are the greatest dangers to the trapped diver.
d. Alert and prepare standby diver; prepare to deploy.
e. Diver attempts to free himself.
f. If required, send standby diver down to assist diver; standby diver to stay with diver.
g. Monitor breathing; if necessary, standby diver shall open diver's free-flow.
h. Standby diver assists injured diver to surface, following proper decompression procedures, except when severity of injuries indicates a greater risk than omitting decompression.
i. When diver is free, if unable or unwilling to continue the dive, or if the standby diver was deployed, terminate the dive.

11. Loss of vital support equipment

a. Evaluate effect on Diver.
b. Inform Diver of problem and action planned.
c. Alert Standby Diver.
d. Alert deck crew.
e. Diver informs topside of his readiness.
f. Activate plan, terminate dive.

12. Loss of gas supply

a. Re-establish breathing media supply by:
b. Activating topside Secondary air supply, or
c. Diver goes on bailout bottle, or
d. Put constant purge on Diver's pneumo hose then have Diver insert the hose into helmet/mask.
e. Alert Standby Diver.
f. Diver goes to descent line or stage.
g. If required, deploy Standby Diver for assistance.
h. Terminate dive.

13. Loss of communications

a. Use line-pull signals at once. Depth, current, bottom or work site conditions may interfere.
b. Check for rising bubbles of air.
c. A cessation or marked decrease of bubbles could be a sign of trouble.
d. Listen for sounds from the diving helmet. If no sound is heard, the circuit may be out of order.
e. If the flow of bubbles seems normal, the diver may be all right.
f. If sounds are heard and the diver does not respond to signals, assume the diver is in trouble.
g. Have divers already on the bottom investigate, or send down the standby diver to do so.

WARNING If only one diver is in the water and no response is received from the diver.
The possibility of contaminated breathing supply should be considered
and a shift to secondary may be required.

h. Bring Diver to first stop or surface once line-pull signals are established.
i. Terminate dive.

14. Injured Diver in Water

a. Diver informs Dive Control of injury and dive is aborted.
b. Alert and prepare standby diver; prepare to deploy.
c. Diver reports nature and extent of injury.
d. If required, send standby diver to assist diver; standby diver should remain with diver.
e. Monitoring breathing. If necessary, standby diver opens diver's free-flow. If breathing stops, overpressure diver's regulator.
f. Standby diver assists injured diver to surface, following proper decompression procedures, except when severity of injury indicates a greater risk than omitting decompression.
g. Institute planned diver recovery procedure.
h. Request required medical assistance and emergency evacuation, if required.

15. Diver Blow Up/Exceeded Ascent Rate to Surface

a. If a Diver appears on the surface unexpectedly, quickly determine if the Diver is okay.

b. Recover the Diver, and deploy Standby Diver if required.
c. Determine amount of decompression missed and treat accordingly.
d. Terminate the dive and recover all Divers. Monitor all Divers thorough clean time and one hour.

16. Diver Loss of Consciousness

a. Unconscious diver during dive
   i. Alert dive team and deploy Standby Diver if necessary.
   ii. Recover Diver to dive station and check for vital signs; administer CPR if required.
   iii. Notify emergency services and transport to recompression chamber.
   iv. Recompression treatment shall be started immediately. A Diver who surfaces unconscious and recovers when exposed to fresh air shall receive a neurological evaluation to rule out arterial gas embolism.

b. Unconscious diver on surface after dive:
   i. Notify emergency services and transport to recompression chamber.

   ii. Recompression treatment shall be started immediately. A Diver who surfaces unconscious and recovers when exposed to fresh air shall receive a neurological evaluation to rule out arterial gas embolism.

17. Injury/Illness of Topside Personnel with Diver in Water

a. Evaluate effect on Diver.
b. Inform Diver of problem and action planned if possible.
c. Alert Standby Diver.
d. Alert deck crew.
e. The Diving Supervisor will direct first Aid/CPR as necessary, determine the course of action, utilize the EAC, and terminate the dive if required.

Table 8.4 Emergency Line-Pull Signals

Signal	From Tender to Diver	From Diver to Tender
4-4-4 Pulls	**n/a**	***"Haul me up immediately"***
3-3-3 Pulls	**n/a**	***"I am fouled but can clear myself"***
2-2-2 Pulls	**n/a**	***"I am fouled and need assistance"***
4 Pulls	***"Come up."***	***"Haul me up."***
3 Pulls	***"Stand by to come up."***	***"Take up my slack."***
2 Pulls	***"Going down."*** **During ascent, 2 pulls mean** ***"You have come up to far; go back down until we stop you."***	***"Lower."*** **Or** ***"Give me slack."***
1 Pull	***"Are you all right?"*** **Or when diver is descending, 1 pull means** ***"Stop."***	***"I am all right."*** **When descending, 1 pull means** ***"Stop"*** **or** ***"I am on the bottom."***

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Appendix F: DIVE and TREATMENT TABLES

No-Decompression Limits and Repetitive Groups

Table 9-7. No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives.

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**Z**
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	63	7	12	17	22	28	33	39	45	51	57	63					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	33	4	7	11	14	17	21	24	28	31	33						
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	12	2	4	6	9	11	12										
140	10	2	4	6	8	10											
150	8		3	5	7	8											
160	7		3	5	6	7											
170	6			4	6												
180	6			4	5	6											
190	5			3	5												

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Table 9-8. Residual Nitrogen Time Table for Repetitive Air Dives.

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

Group at Beginning	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.

No-Decompression Limit and Repetitive Group for Shallow Water Dives

Table 2A-1. *No-Decompression Limits and Repetitive Group Designators for Shallow Water Air No-Decompression Dives.*

Depth (fsw)	No-Stop Limit (min)	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
31	334	16	26	37	48	60	73	87	102	119	138	158	182	209	242	282	334
32	304	15	25	35	46	58	70	83	98	114	131	150	172	197	226	261	304
33	281	15	24	34	45	56	67	80	94	109	125	143	163	186	212	243	281
34	256	14	23	33	43	54	65	77	90	104	120	137	155	176	200	228	256
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
36	212	14	22	31	40	50	61	72	84	97	110	125	142	160	180	204	212
37	197	13	21	30	39	49	59	69	81	93	106	120	136	153	172	193	197
38	184	13	21	29	38	47	57	67	78	90	102	116	131	147	164	184	
39	173	12	20	28	37	46	55	65	76	87	99	112	126	141	157	173	
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
41	155	12	19	27	35	43	52	61	71	81	92	104	117	130	145	155	
42	147	11	19	26	34	42	50	59	69	79	89	101	113	126	140	147	
43	140	11	18	25	33	41	49	58	67	76	87	98	109	122	135	140	
44	134	11	18	25	32	40	48	56	65	74	84	95	106	118	130	134	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
46	116	10	17	23	30	38	45	53	61	70	79	89	99	110	116		
47	109	10	16	23	30	37	44	52	60	68	77	87	97	107	109		
48	102	10	16	22	29	36	43	51	58	67	75	84	94	102			
49	97	10	16	22	28	35	42	49	57	65	73	82	91	97			
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			

Table 2A-2. Residual Nitrogen Time Table for Repetitive Shallow Water Air Dives.

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

Group	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
31	334	282	243	210	183	159	139	120	103	88	74	61	49	38	27	17
32	305	262	227	198	173	151	132	115	99	85	71	59	47	36	26	17
33	282	244	213	187	164	144	126	110	95	81	69	57	46	35	25	16
34	262	229	201	177	156	138	121	105	91	78	66	55	44	34	25	16
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
36	231	204	181	161	143	126	111	98	85	73	62	51	41	32	23	15
37	218	194	173	154	137	122	107	94	82	70	60	50	40	31	23	14
38	207	185	165	148	132	117	103	91	79	68	58	48	39	30	22	14
39	197	177	158	142	127	113	100	88	77	66	56	47	38	29	21	14
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
41	180	163	146	132	118	105	93	82	72	62	53	44	36	28	20	13
42	173	156	141	127	114	102	91	80	70	61	52	43	35	27	20	13
43	166	150	136	123	110	99	88	78	68	59	50	42	34	26	19	12
44	160	145	131	119	107	96	85	75	66	57	49	41	33	26	19	12
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
46	149	136	123	111	101	90	81	71	63	54	46	39	32	25	18	12
47	144	131	119	108	98	88	78	70	61	53	45	38	31	24	18	11
48	139	127	116	105	95	85	76	68	60	52	44	37	30	24	17	11
49	135	123	112	102	92	83	74	66	58	51	43	36	30	23	17	11
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11

Residual Nitrogen Times (Minutes)

Repetitive Dive Worksheet

REPETITIVE DIVE WORKSHEET

							Date:
1st DIVE							
Max Depth							
Bottom Time							
Table & Schedule						REPET Group	
Surface Interval						New Group	
2nd DIVE							
Max Depth		MD + ESDT = Table & Schedule					
Bottom Time	+	RNT	=	ESDT	=	Table & Schedule	REPET Group
	+		=		=		
Ensure the RNT Exception Rule does not apply							
Surface Interval						New Group	
3rd DIVE							
Max Depth		MD + ESDT = Table & Schedule					
Bottom Time	+	RNT	=	ESDT	=	Table & Schedule	REPET Group
	+		=		=		
Ensure the RNT Exception Rule does not apply							
Surface Interval						New Group	
4th DIVE							
Max Depth		MD + ESDT = Table & Schedule					
Bottom Time	+	RNT	=	ESDT	=	Table & Schedule	REPET Group
	+		=		=		
Ensure the RNT Exception Rule does not apply							
Surface Interval						New Group	

Figure 9-9. Repetitive Dive Worksheet.

Date: ________________

DIVING AT ALTITUDE WORKSHEET

Actual Dive Site Altitude ________________ feet

1. Altitude from Table 9-4 ________ feet
2. Actual Depth of Dive (Corrected per Section 9-13.3) ________ fsw
3. Sea Level Equivalent Depth from Table 9-4 ________ SLED
4. Repetitive Group from Table 9-5 ________
5. Time at Altitude ________ hrs ________ min
6. New Repetitive Group Designator from Table 9-8 ________
7. Residual Nitrogen Time ________ min
8. Planned Bottom Time + ________ min
9. Equivalent Single Dive Time = ________ min
10. Decompression Mode

    ☐ No-Decompression ☐ In-water Air/Oxygen Decompression

    ☐ In-water Air Decompression ☐ Surface Decompression Using Oxygen

11. Table/Schedule _______ / _______
12. Decompression Schedule

Sea Level Stop Depth	Altitude Stop Depth	Water Stop Time	Chamber Stop Time
60 fsw	________ fsw	________ min	
50 fsw	________ fsw	________ min	________ min *
40 fsw	________ fsw	________ min	________ min *
30 fsw	________ fsw	________ min	________ min *
20 fsw	________ fsw	________ min	

13. Repetitive Group Designator ______

* Chamber stops on SurDO$_2$ will be at 50, 40, and 30 fsw

Figure 9-15. Diving at Altitude Worksheet

REPETITIVE DIVE AT ALTITUDE WORKSHEET Date: ______________

1. PREVIOUS DIVE

Decompression Mode

_____ minutes ☐ No-Decompression ☐ In-water Air/Oxygen Decompression

_____ SLED ☐ In-water Air Decompression ☐ Surface Decompression Using Oxygen

_____ Repetitive Group Letter Designator

2. SURFACE INTERVAL

_____ hours ______ minutes on surface

_____ repetitive group from item 1 above

_____ new repetitive group letter designator from Residual Nitrogen Timetable

3. RESIDUAL NITROGEN TIME FOR REPETITIVE DIVE

Altitude from Table 9-4 _________ feet

Actual Depth of Dive (corrected per section 9-13.3) _________ fsw

Sea Level Equivalent Depth of repetitive dive from Table 9-4 _________ SLED

_____ new repetitive group letter designator from item 2 above

______ minutes, residual nitrogen time from Residual Nitrogen Timetable

4. EQUIVALENT SINGLE DIVE TIME

_____ minutes, residual nitrogen time from item 3 above

\+ _____ minutes, actual bottom time of repetitive dive

= _____ minutes, equivalent single dive time

5. DECOMPRESSION FOR REPETITIVE DIVE

_____ SLED of repetitive dive

_____ minutes, equivalent single dive time from item 4 above

Decompression Mode (check one)

☐ No-Decompression ☐ In-water Air/Oxygen Decompression

☐ In-water Air Decompression ☐ Surface Decompression Using Oxygen

___________ schedule used (depth/time)

Sea Level Stop Depth	Altitude Stop Depth	Water Stop Time	Chamber Stop Time
60 fsw	_________ fsw	_________ min	
50 fsw	_________ fsw	_________ min	_________ min*
40 fsw	_________ fsw	_________ min	_________ min*
30 fsw	_________ fsw	_________ min	_________ min*
20 fsw	_________ fsw	_________ min	

13. Repetitive Group Letter Designator ______

* Chamber stops on SurDO_2 will be at 50, 40, and 30 fsw

Figure 9-18. Repetitive Dive at Altitude Worksheet.

Table 9-4. *Sea Level Equivalent Depth (fsw).*

Actual Depth (fsw)	Altitude (feet)									
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10	10	15	15	15	15	15	15	15	15	15
15	15	20	20	20	20	20	20	25	25	25
20	20	25	25	25	25	25	30	30	30	30
25	25	30	30	30	35	35	35	35	35	40
30	30	35	35	35	40	40	40	45	45	45
35	35	40	40	45	45	45	50	50	50	60
40	40	45	45	50	50	50	55	55	60	60
45	45	50	55	55	55	60	60	70	70	70
50	50	55	60	60	70	70	70	70	70	80
55	55	60	70	70	70	70	80	80	80	80
60	60	70	70	70	80	80	80	90	90	90
65	65	70	80	80	80	90	90	90	100	100
70	70	80	80	90	90	90	100	100	100	110
75	75	90	90	90	100	100	100	110	110	110
80	80	90	90	100	100	100	110	110	120	120
85	85	100	100	100	110	110	120	120	120	130
90	90	100	110	110	110	120	120	130	130	140
95	95	110	110	110	120	120	130	130	140	140
100	100	110	120	120	130	130	130	140	140	150
105	105	120	120	130	130	140	140	150	150	160
110	110	120	130	130	140	140	150	150	160	160
115	115	130	130	140	140	150	150	160	170	170
120	120	130	140	140	150	150	160	170	170	180
125	125	140	140	150	160	160	170	170	180	190
130	130	140	150	160	160	170	170	180	190	190
135	135	150	160	160	170	170	180	190	190	200
140	140	160	160	170	170	180	190	190	200	210
145	145	160	170	170	180	190	190	200	210	
150	160	170	170	180	190	190	200	210		
155	170	170	180	180	190	200	210			
160	170	180	180	190	200	200				
165	180	180	190	200	200					
170	180	190	190	200						
175	190	190	200							
180	190	200	210							
185	200	200								
190	200									
Table Water Stops	**Equivalent Stop Depths (fsw)**									
10	10	9	9	9	8	8	8	7	7	7
20	19	19	18	17	17	16	15	15	14	14
30	29	28	27	26	25	24	23	22	21	21
40	39	37	36	35	33	32	31	30	29	28
50	48	47	45	43	42	40	39	37	36	34
60	58	56	54	52	50	48	46	45	43	41

Note: ——— = Exceptional Exposure Limit

9-13.3 Depth Measurement at Altitude. The preferred method for measuring depth at altitude is a mechanical or electronic gauge that can be re-zeroed at the dive site. Once re-zeroed, no further correction of the reading is required.

When using a recompression chamber for decompression, zero the chamber depth gauges before conducting surface decompression.

Most mechanical depth gauges carried by divers have a sealed one-atmosphere reference and cannot be adjusted for altitude; thus they will read low throughout a dive at altitude. A correction factor of 1 fsw for every 1000 feet of altitude should be added to the reading of a sealed reference gauge before entering Table 9-4.

Pneumofathometers can be used at altitude. Add the pneumofathometer correction factor (Table 9-1) to the depth reading before entering Table 9-4. The pneumofathometer correction factors are unchanged at altitude.

A sounding line or fathometer may be used to measure the depth if a suitable depth gauge is not available. These devices measure the linear distance below the surface of the water, not the water pressure. Though fresh water is less dense than sea water, all dives will be assumed to be conducted in sea water, thus no corrections will be made based on water salinity. Enter Table 9-4 directly with the depth indicated on the line or fathometer.

Table 9-5. *Repetitive Groups Associated with Initial Ascent to Altitude.*

Altitude (feet)	Repetitive Group
1000	A
2000	A
3000	B
4000	C
5000	D
6000	E
7000	F
8000	G
9000	H
10000	I

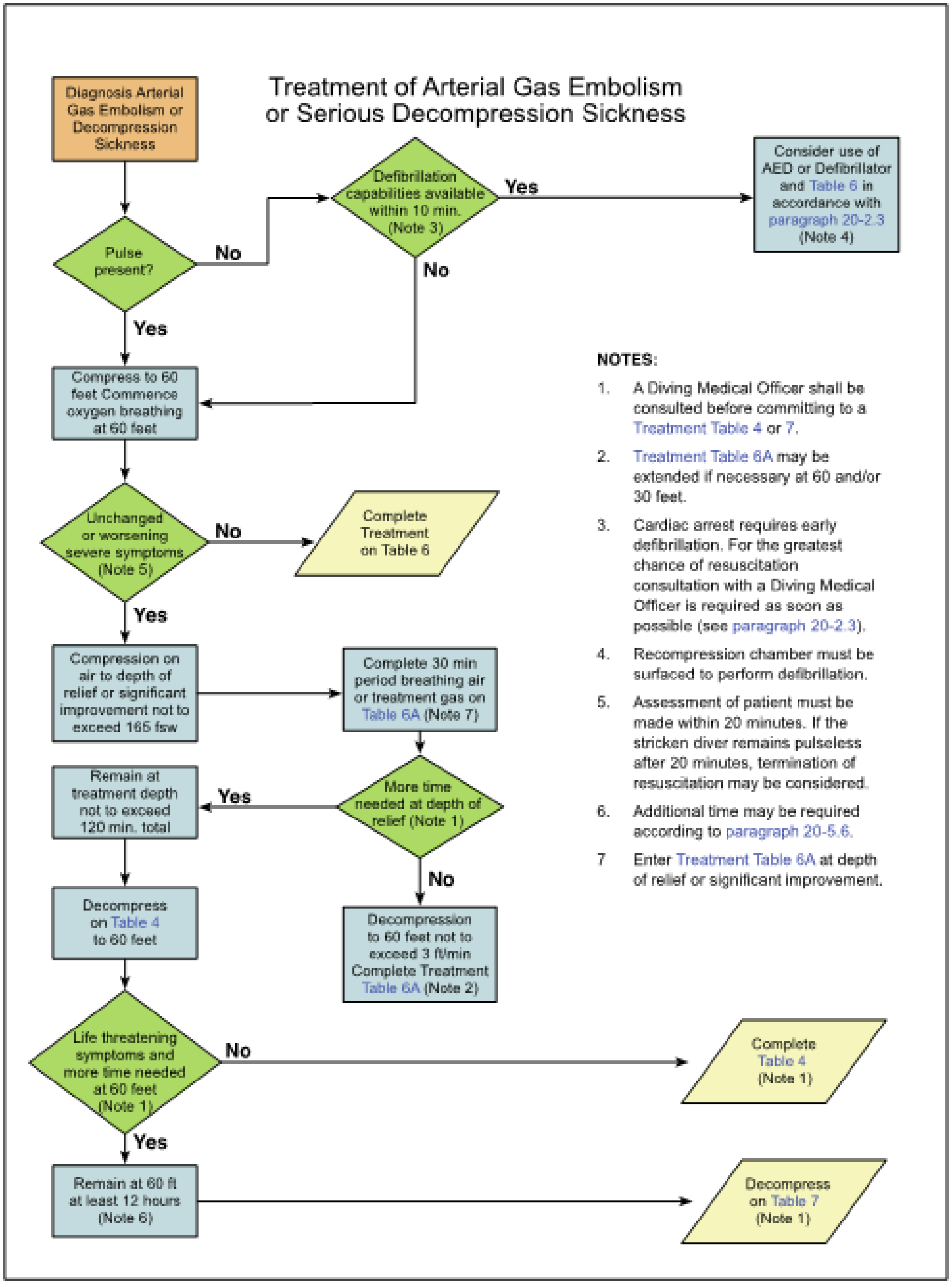


Figure 20-1. Treatment of Arterial Gas Embolism or Serious Decompression Sickness.

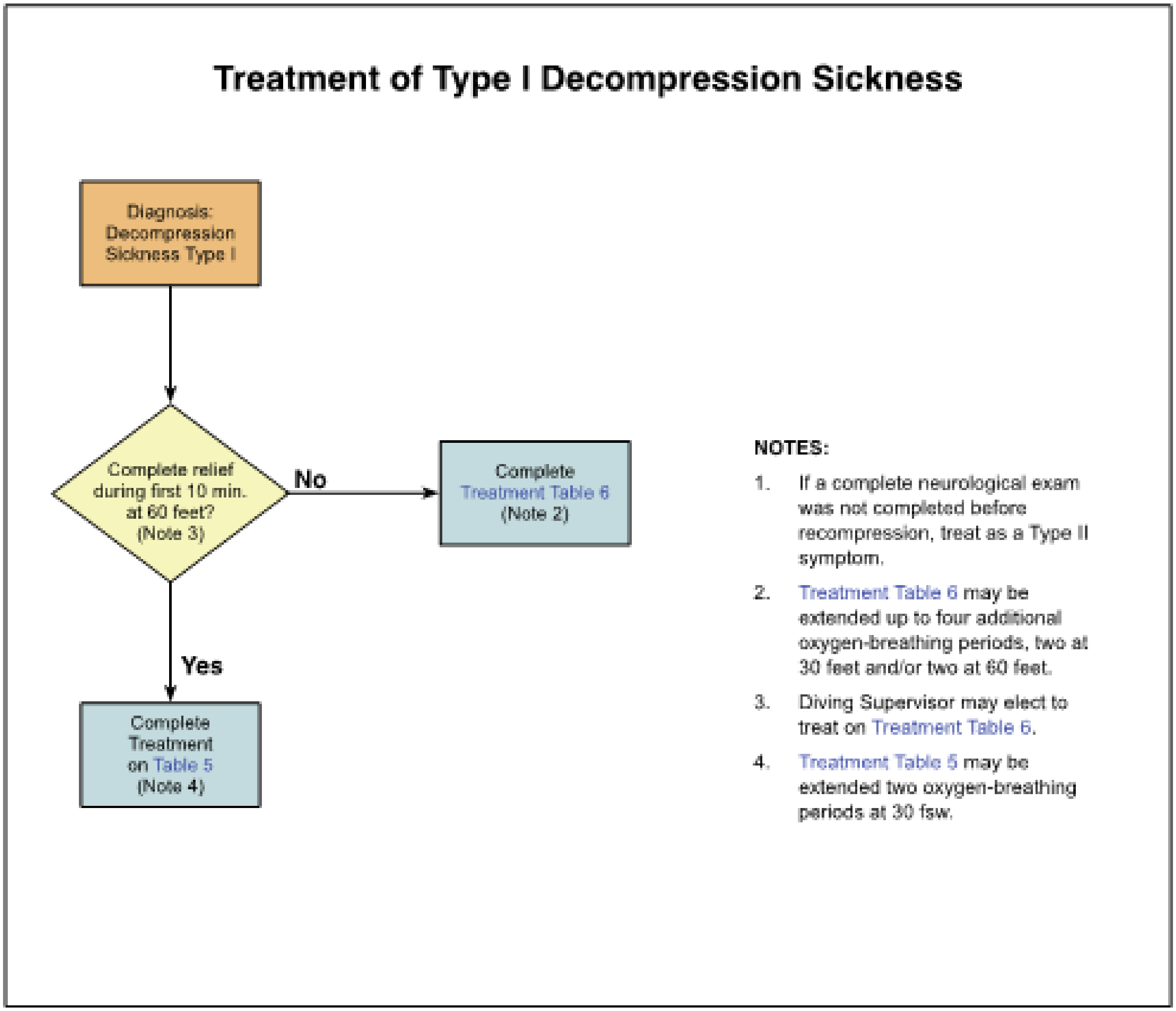


Figure 20-2. Treatment of Type I Decompression Sickness.

20-12.4.1 **Modification of Emergency Kits.** Because the available facilities may differ on board ship, at land-based diving installations, and at diver training or experimental units, the responsible Diving Medical Officer or Diving Medical Technician are authorized to augment the emergency kits to suit the local needs.

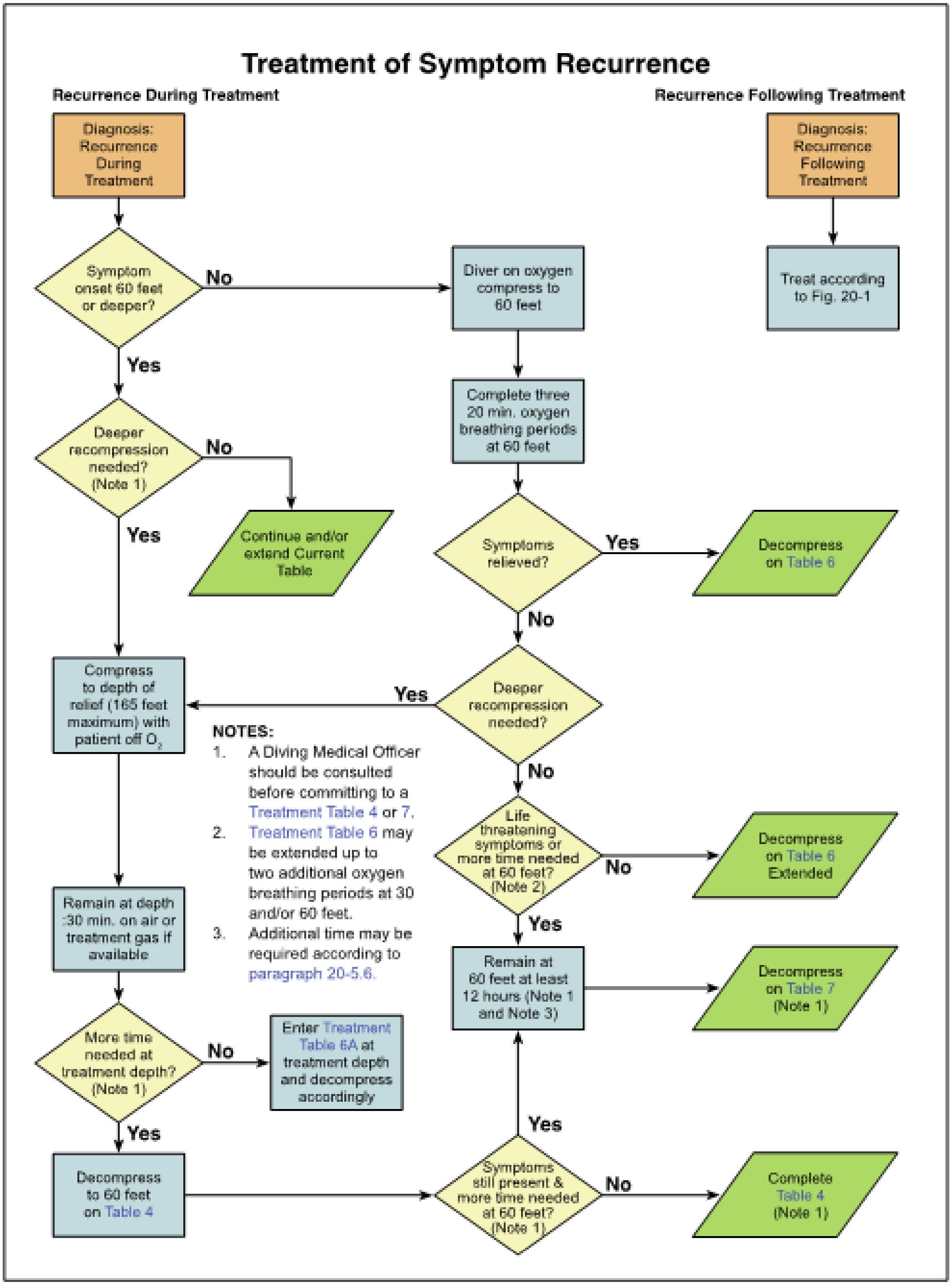


Figure 20-3. Treatment of Symptom Recurrence.

Treatment Table 5

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 20-7.11.1.1)
5. Treatment Table may be extended two oxygen-breathing periods at the 30-foot stop. No air break required between oxygen-breathing periods or prior to ascent.
6. Tender breathes 100 percent O_2 during ascent from the 30-foot stop to the surface. If the tender had a previous hyperbaric exposure in the previous 18 hours, an additional 20 minutes of oxygen breathing is required prior to ascent.

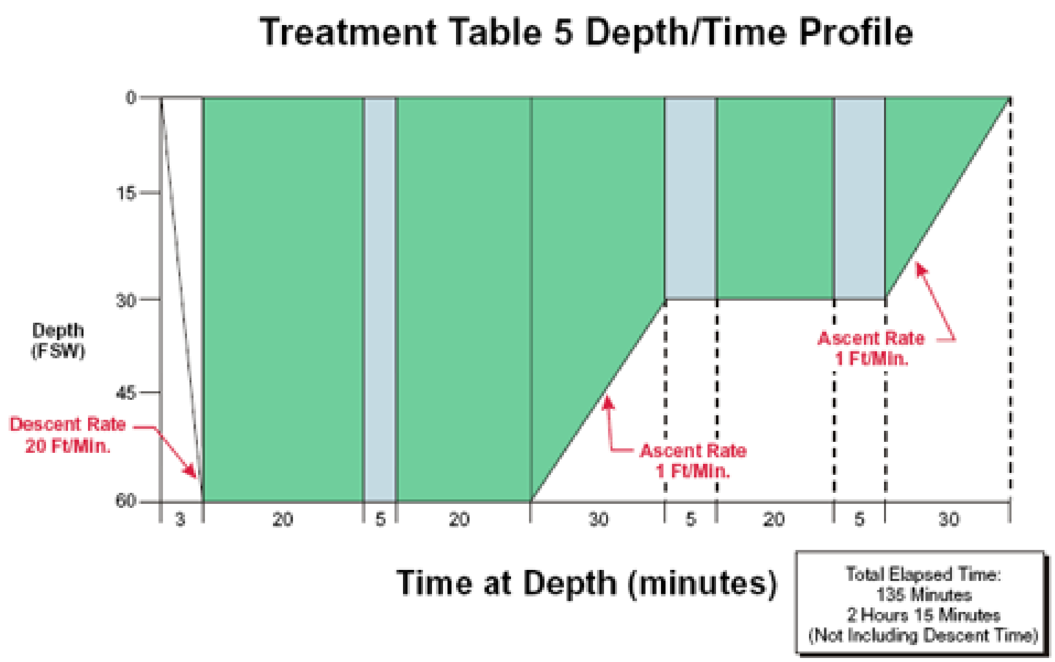


Figure 20-4. Treatment Table 5.

Treatment Table 6

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 20-7.11.1.1).
5. Table 6 can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (15 minutes on air and 60 minutes on oxygen), or both.
6. Tender breathes 100 percent O_2 during the last 30 min. at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 feet. If there has been more than one extension, the O_2 breathing at 30 feet is increased to 60 minutes. If the tender had a hyperbaric exposure within the past 18 hours an additional 60-minute O_2 period is taken at 30 feet.

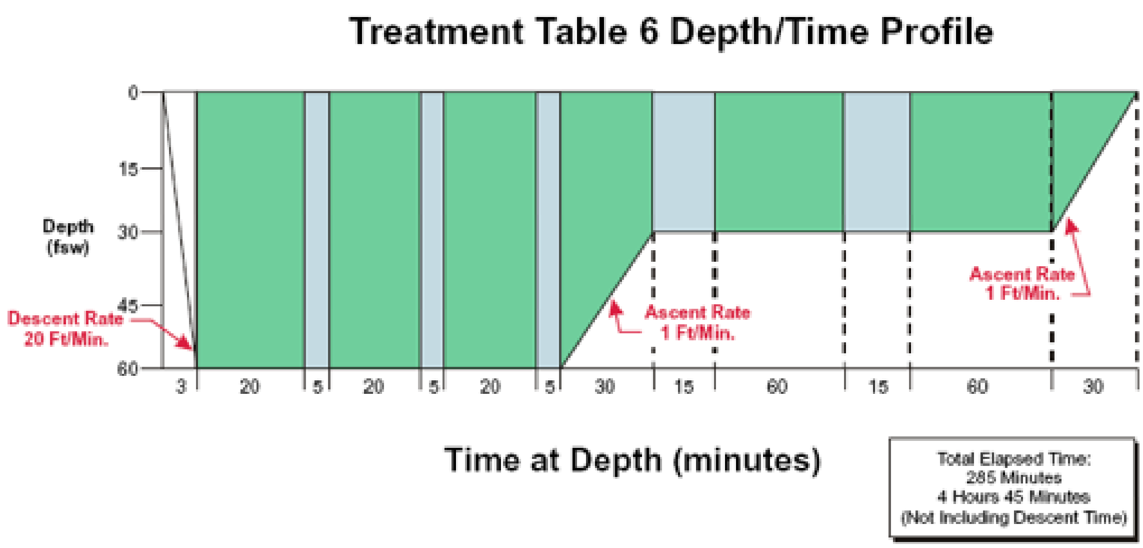


Figure 20-5. Treatment Table 6.

Treatment Table 6A

1. Descent rate - 20 ft/min.
2. Ascent rate - 165 fsw to 60 fsw not to exceed 3 ft/min, 60 fsw and shallower, not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time at treatment depth does not include compression time.
4. Table begins with initial compression to depth of 60 fsw. If initial treatment was at 60 feet, up to 20 minutes may be spent at 60 feet before compression to 165 fsw. Contact a Diving Medical Officer.
5. If a chamber is equipped with a high-O_2 treatment gas, it may be administered at 165 fsw and shallower, not to exceed 3.0 ata O_2 in accordance with paragraph 20-7.10. Treatment gas is administered for 25 minutes interrupted by 5 minutes of air. Treatment gas is breathed during ascent from the treatment depth to 60 fsw.
6. Deeper than 60 feet, if treatment gas must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided before resuming treatment gas. The time off treatment gas is counted as part of the time at treatment depth. If at 60 feet or shallower and oxygen breathing must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 20-7.11.1.1).
7. Table 6A can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (60 minutes on oxygen and 15 minutes on air), or both.
8. Tender breathes 100 percent O_2 during the last 60 minutes at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 fsw. If there has been more than one extension, the O_2 breathing at 30 fsw is increased to 90 minutes. If the tender had a hyperbaric exposure within the past 18 hours, an additional 60 minute O_2 breathing period is taken at 30 fsw.
9. If significant improvement is not obtained within 30 minutes at 165 feet, consult with a Diving Medical Officer before switching to Treatment Table 4.

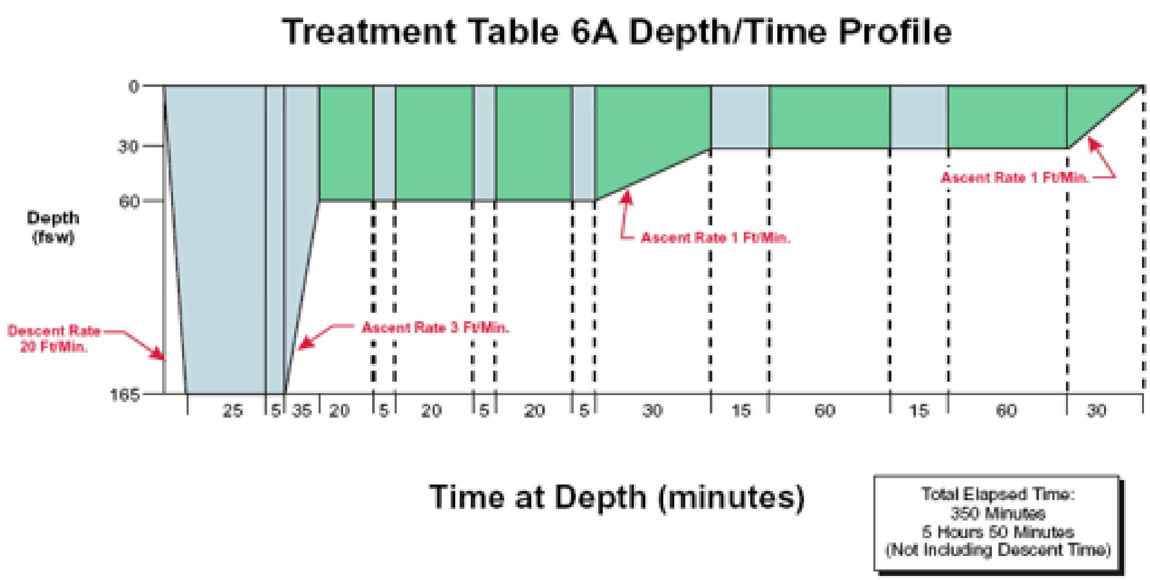


Figure 20-6. Treatment Table 6A.

Treatment Table 4

1. Descent rate - 20 ft/min.
2. Ascent rate - 1 ft/min.
3. Time at 165 feet includes compression.
4. If only air is available, decompress on air. If oxygen is available, patient begins oxygen breathing upon arrival at 60 feet with appropriate air breaks. Both tender and patient breathe oxygen beginning 2 hours before leaving 30 feet. (see paragraph 20-5.5).
5. Ensure life-support considerations can be met before committing to a Table 4. (see paragraph 20-7.5) Internal chamber temperature should be below 85° F.
6. If oxygen breathing is interrupted, no compensatory lengthening of the table is required.
7. If switching from Treatment Table 6A or 3 at 165 feet, stay a maximum of 2 hours at 165 feet before decompressing.
8. If the chamber is equipped with a high-O_2 treatment gas, it may be administered at 165 fsw, not to exceed 3.0 ata O_2. Treatment gas is administered for 25 minutes interrupted by 5 minutes of air.

Treatment Table 4 Depth/Time Profile

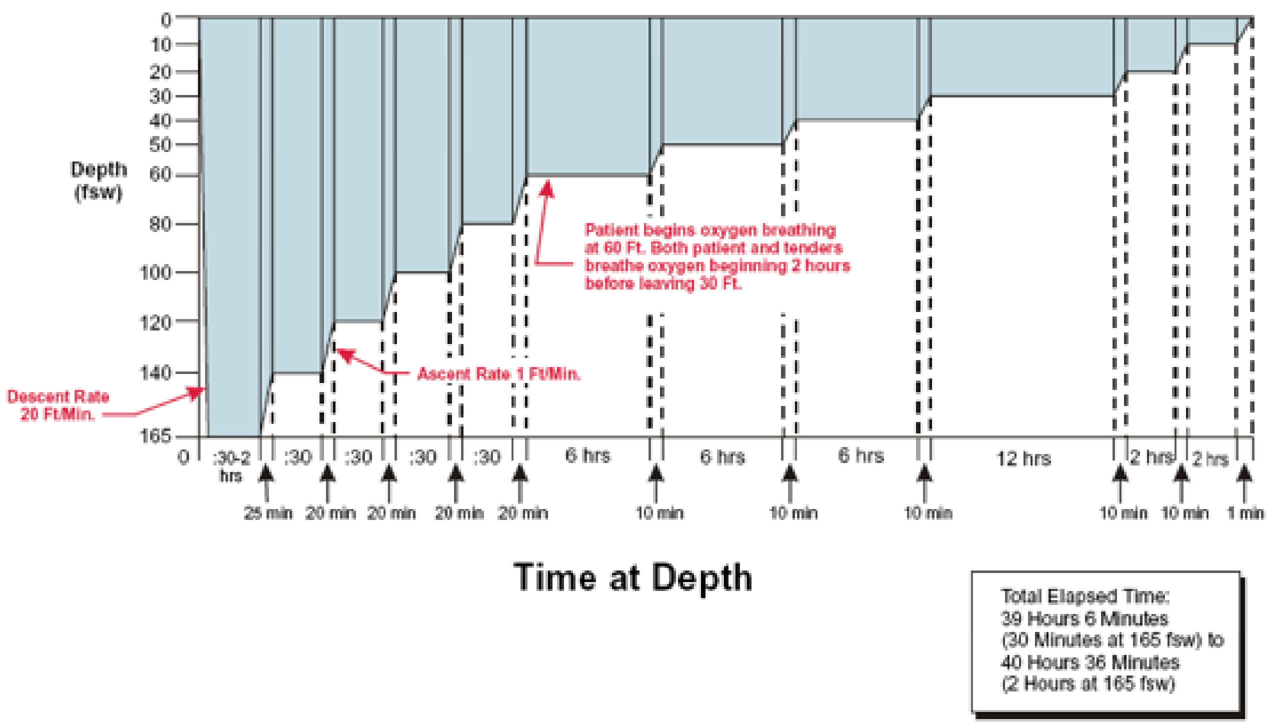


Figure 20-7. Treatment Table 4.

Neurological Examination Checklist

NEUROLOGICAL EXAMINATION CHECKLIST

(Sheet 1 of 2)

(See text of Appendix 5A for examination procedures and definitions of terms.)

Patient's Name: ______________________________ Date/Time: ______________________

Describe pain/numbness: ____

____

HISTORY

Type of dive last performed: ______________ Depth: __________ How long: ______________

Number of dives in last 24 hours: ____

Was symptom noticed before, during or after the dive? ____________________________

If during, was it while descending, on the bottom or ascending? _______________________

Has symptom increased or decreased since it was first noticed? _______________________

Have any other symptoms occurred since the first one was noticed? ____________________

Describe: ____

Has patient ever had a similar symptom before? ______________ When: __________________

____

MENTAL STATUS/STATE OF CONSCIOUSNESS

____

____

COORDINATION

Walk: ________

Heel-to Toe: ________

Romberg: ________

Finger-to-Nose: ________

Heel Shin Slide: ________

Rapid Movement: ________

CRANIAL NERVES

Sense of Smell (I): ________

Vision/Visual Fld (II): ________

Eye Movements, Pupils (III, IV, VI): ________

Facial Sensation, Chewing (V): ________

Facial Expression Muscles (VII): ________

Hearing (VIII): ________

Upper Mouth, Throat Sensation (IX): ________

Gag & Voice (X): ________

Shoulder Shrug (XI): ________

Tongue (XII): ________

STRENGTH (Grade 0 to 5)

UPPER BODY

Deltoids L ______ R ______

Latissimus L ______ R ______

Biceps L ______ R ______

Triceps L ______ R ______

Forearms L ______ R ______

Hand L ______ R ______

LOWER BODY

HIPS

Flexion L ______ R ______

Extension L ______ R ______

Abduction L ______ R ______

Adduction L ______ R ______

KNEES

Flexion L ______ R ______

Extension L ______ R ______

ANKLES

Dorsiflexion L ______ R ______

Plantarflexion L ______ R ______

TOES

L ______ R ______

Figure 5A-1a. Neurological Examination Checklist (sheet 1 of 2).

NEUROLOGICAL EXAMINATION CHECKLIST

(Sheet 2 of 2)

REFLEXES

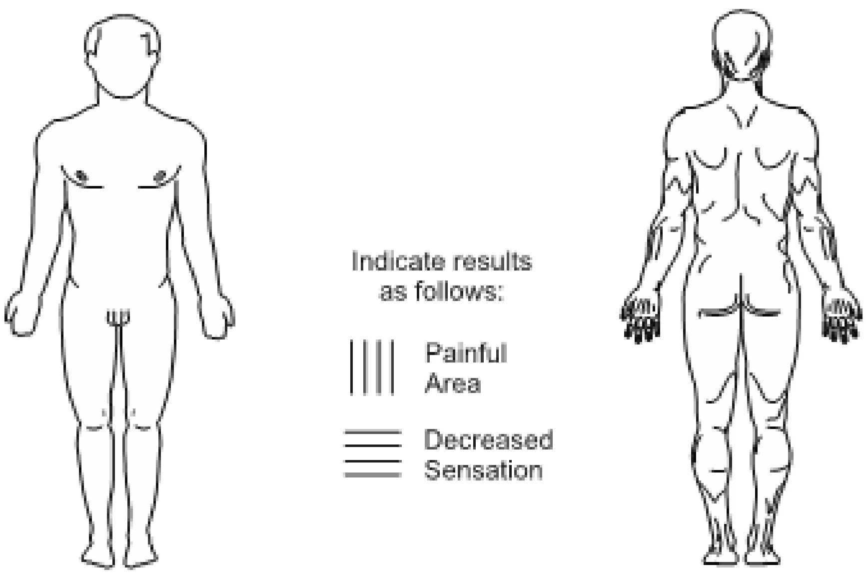
(Grade: Normal, Hypoactive, Hyperactive, Absent)

Biceps	L ______________________________	R ______________________________
Triceps	L ______________________________	R ______________________________
Knees	L ______________________________	R ______________________________
Ankles	L ______________________________	R ______________________________

Sensory Examination for Skin Sensation

(Use diagram to record location of sensory abnormalities – numbness, tingling, etc.)

LOCATION



COMMENTS

____

____

____

____

____

____

____

____

Examination Performed by: ____

Figure 5A-1b. Neurological Examination Checklist (sheet 2 of 2).

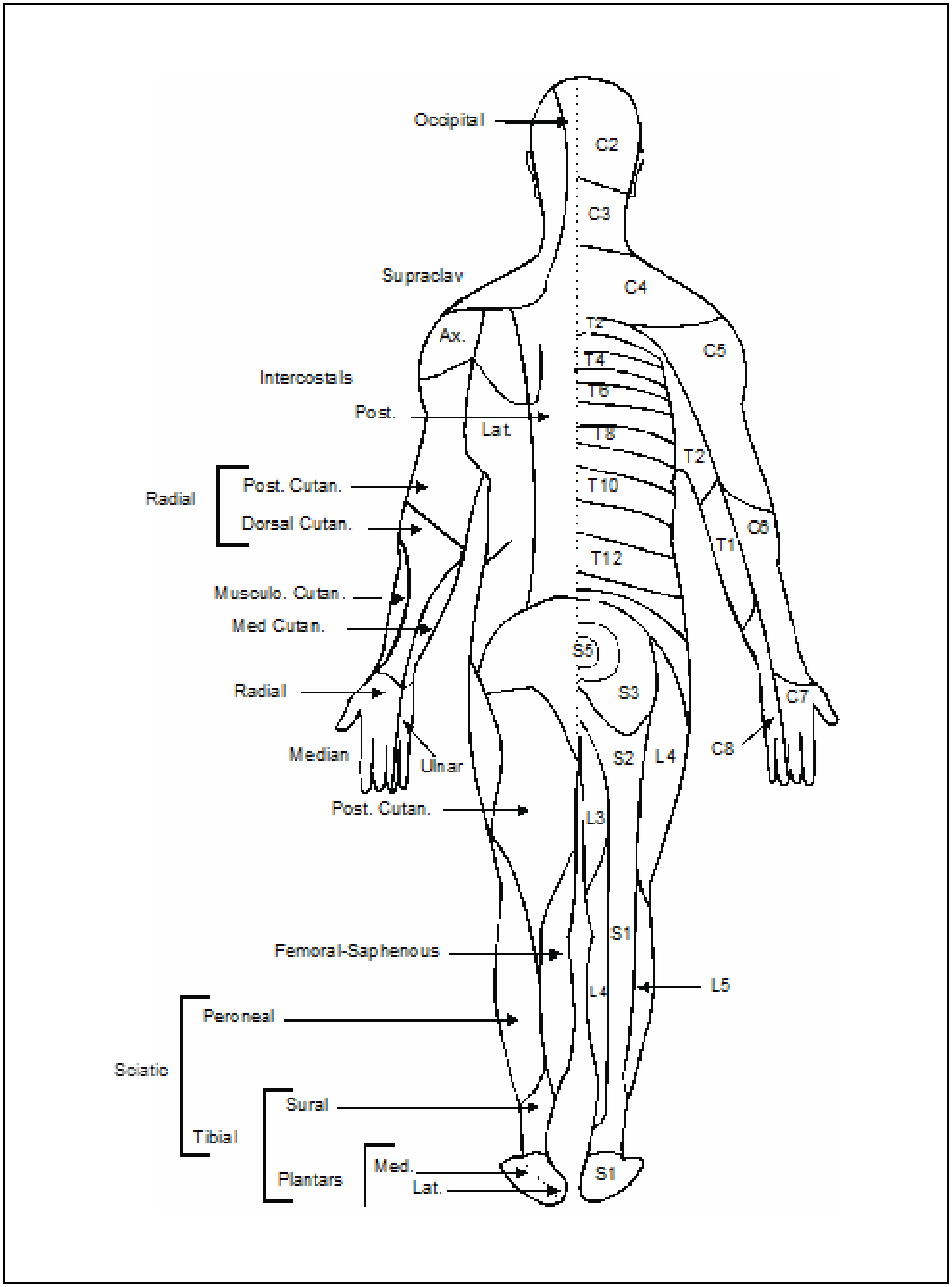


Figure 5A-2a. Dermatomal Areas Correlated to Spinal Cord Segment (sheet 1 of 2).

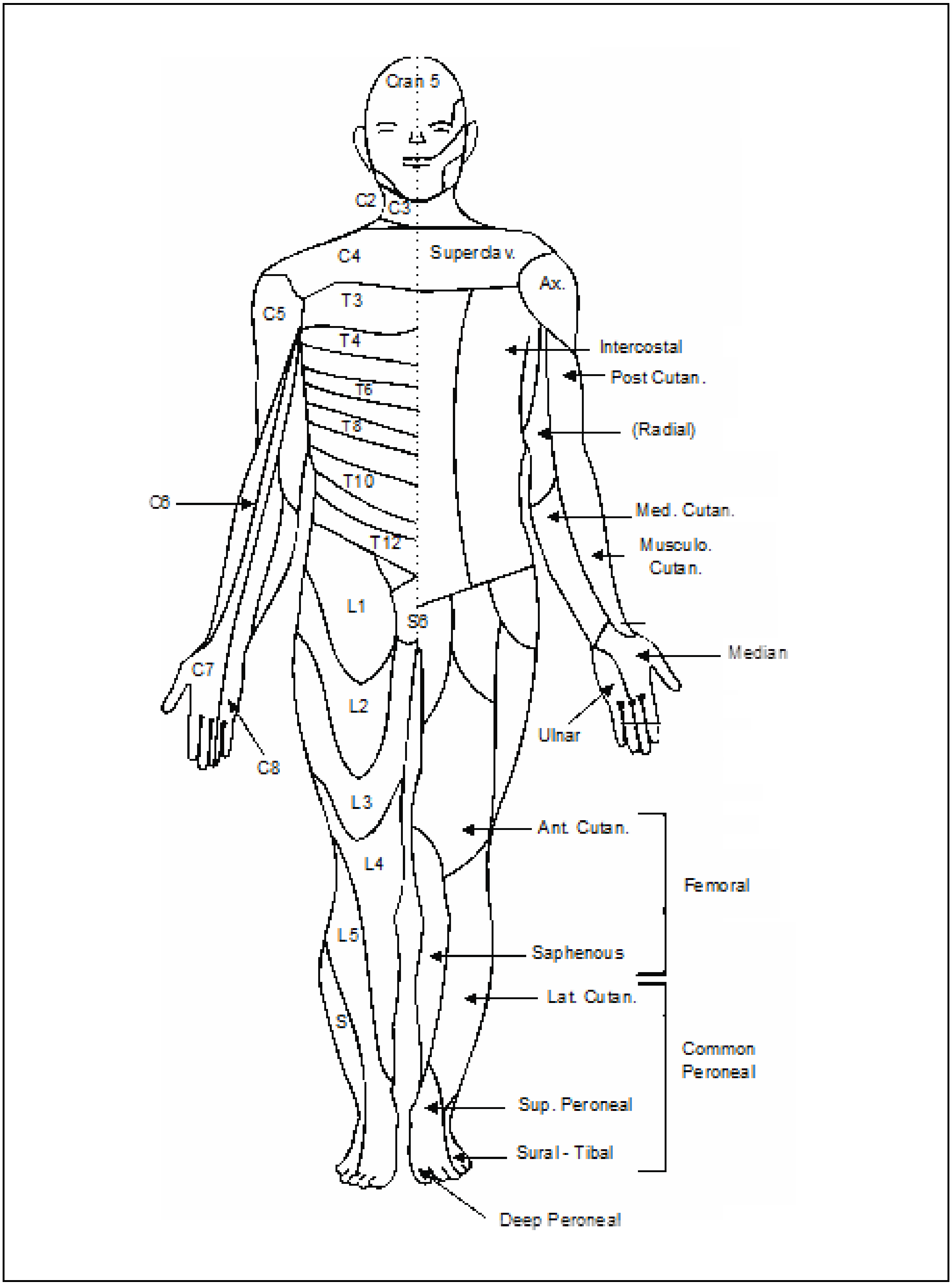


Figure 5A-2b. Dermatomal Areas Correlated to Spinal Cord Segment (sheet 2 of 2).

2016

Appendix G: AOR GUIDELINES for MEDICAL EXAMINATION of DIVERS

AOR employees require periodic medical exams are required to mitigate acute risks of DCS and POIS and monitor for chronic health risks due to exposure to hazardous substances. Additionally, employees may require immunizations / foreign travel clearance incident to foreign travel.

AOR utilizes WorkCare, Inc. exclusively for all company employee occupational health needs. Personal health concerns should be attended to via individual employee health plan options.

Some instances that may prompt a request for a WorkCare appointment:

- Pre-employment Exams
- Drug Testing
- Travel Medicine (Travel Care)
- Hearing Conservation
- Respiratory Compliance
- Human Performance Evaluations
- Dive medical clearance
- HAZWOPER clearance

AOR employees requiring medical clearance shall submit a WorkCare request to AOR HR via their supervisor utilizing the Work Care request form. Employees are responsible for making all scheduled appointments and for NOT submitting ANY personal health (HIPPA) related information to AOR supervisors, managers and staff via any means.

Request for Physical Examination Form:

AOR Work Care Request

submitted by: Date of Request: Appt needed by:

Employee Name:	Type of Exam Requested / Immunizations:	Location traveling to (if immunizations needed)	Phone number:	Desired appt. location	Employee current street address (not necessarily home address due to traveling)	Employee received appt noticication?

Additional Notes:						

Employees performing hazardous work shall be entered into AOR's medical surveillance program with initial and periodic exams. Employees performing diving shall receive base line and annual exams as follows with the basic requirements below:

Medical Tests for Diving:

Test	Initial	Annual	Comments
History & Physical	X	X	Include predisposition to unconsciousness, vomiting, cardiac arrest, impairment of oxygen transport, serious blood loss or anything that, in the opinion of the examining physician, will interfere with effective underwater work.
Chest X-ray	X	X	PA and lateral (Projection: 14" x 17" minimum) every three years unless medical conditions dictate otherwise.
Bone and Joint X-ray Survey	X		Optional and as medically indicated.
EKG: Standard (12 Leads)	X		Optional initially to establish baseline; annually after age 35; and as medically indicated.
EKG: Stress Test			Required as medically indicated if the Framingham Risk Score indicates risk of >10%.
Spirometry	X	X	Required including FVC, FEV1 and FEF25-75. Tests should be compared with NHANESIII reference values for determining percent of predicted
Audiogram	X	X	Threshold audiogram by pure tone audiometry; bone conduction audiogram as medically indicated.
EEG			Required only as medically indicated.
Visual Acuity	X	X	Required initially and annually.
Color Blindness	X		Required.
Complete Blood Count	X	X	
Routine Urinalysis	X	X	
Pregnancy Test	X	X	Recommended prior to saturation diving.
Sickle Cell Screen	X		Optional.
TB screening	X	X	Optional.
Comprehensive Metabolic Profile	X	X	Optional, including cholesterol and triglycerides required for divers over 40.
Framingham Risk Score	X	X	Required annually after the age of 35

WorkCare will issue a medical clearance letter similar to the sample letter below within five business days of the scheduled health exam. The employee will receive exam findings within ten days of the scheduled exam. Ensure the reviewing physician is a knowledgeable in the physiology of diving.

WorkCare issues letter of Clarence:

WorkCare MAKING HEALTH COUNT

WORK STATUS REPORT
Employer Copy

TYPE OF EXAMINATION: **Annual Exam: Fit To Dive**
EXAM CLASSIFICATION: **Periodic Examination**

EMPL[redacted]
ID:
DATE OF EXAM: **08/31/2016**
EXPIRATION DATE: **08/31/2017**

COMPANY: **AOR International INC**
POSITION: **Supervisor**
LOCATION: **AOR International INC**
SITE:

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

	Yes	**No**	**Undecided**
Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)?	☐	X	☐
Has the employee any contraindication for work in accordance with 29 CFR §1910.95(g)1926.52 (Hearing Conservation)?	☐	X	☐
Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)?	☐	X	☐

<u>STATUS</u>

[X] **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

[ ] **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

[ ] **NOT QUALIFIED**

[ ] **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

<u>COMMENTS:</u>

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: John Longphre, MD, MPH, DMO Date: 09/07/16

Signature: MD MPH

300 S. Harbor Blvd., Ste. 600, Anaheim, CA 92805

In the absence of an available WorkCare provider, diving clearance may be accepted from other providers. In these cases, the diving clearance shall be documented on the AOR sample form at the end of this appendix.

AOR INTERNATIONAL

EXAMINING PHYSICIAN'S STATEMENT

Patient's Name: ________________________________ **Soc. Sec. Number:** ____________

Date of Birth: __________**Date of Exam:** _______ **Type of Exam:** **Dive Physical**

OPINION OF RISK AND MEDICAL CLEARANCE FOR DIVING OPERATIONS
I have reviewed the employee's occupational and medical history and the results of the physical examination and laboratory tests. I certify that this individual has undergone a physical examination in accordance with 385.1, Chapter 30. (*Check appropriate opinion*)

( ) Has no medical condition that would place the individual at increased risk from the known diving duties when they are conducted with adequate training and implementation of a health and safety plan. Therefore, the individual **IS** "fit to dive"

( ) Has a medical condition that would place the individual at increased risk of health impairment from the known diving duties or exposures of the job. Therefore, the individual is **NOT** "fit to dive".

( ) Has been deferred, pending further evaluation.

MEDICAL CLEARANCE FOR RESPRIATOR USE
Based upon the results of the examination referenced above, I certify that this individual has been evaluated in accordance with OSHA standard 29CFR 1910.134 and: (*check appropriate opinion*)

( ) is medically qualified to use properly fitted respiratory protection equipment when required

( ) is not medically qualified to use respirator protection equipment when required.

COMMENTS/RECOMMENDATIONS/RESTRICTIONS
As a result of the physical examination and laboratory analyses conducted for the above listed employee, the following comments, recommendations, and/or restrictions have been determined to be necessary (if needed attach additional pages);

EMPLOYEE NOTIFICATION
This individual has been informed of the results of this medical examination. Detected medical conditions which require additional examinations or treatment have been explained and applicable follow-up recommended. (*Physicians stamp required*)

Name of the Medical Center/Group: ____

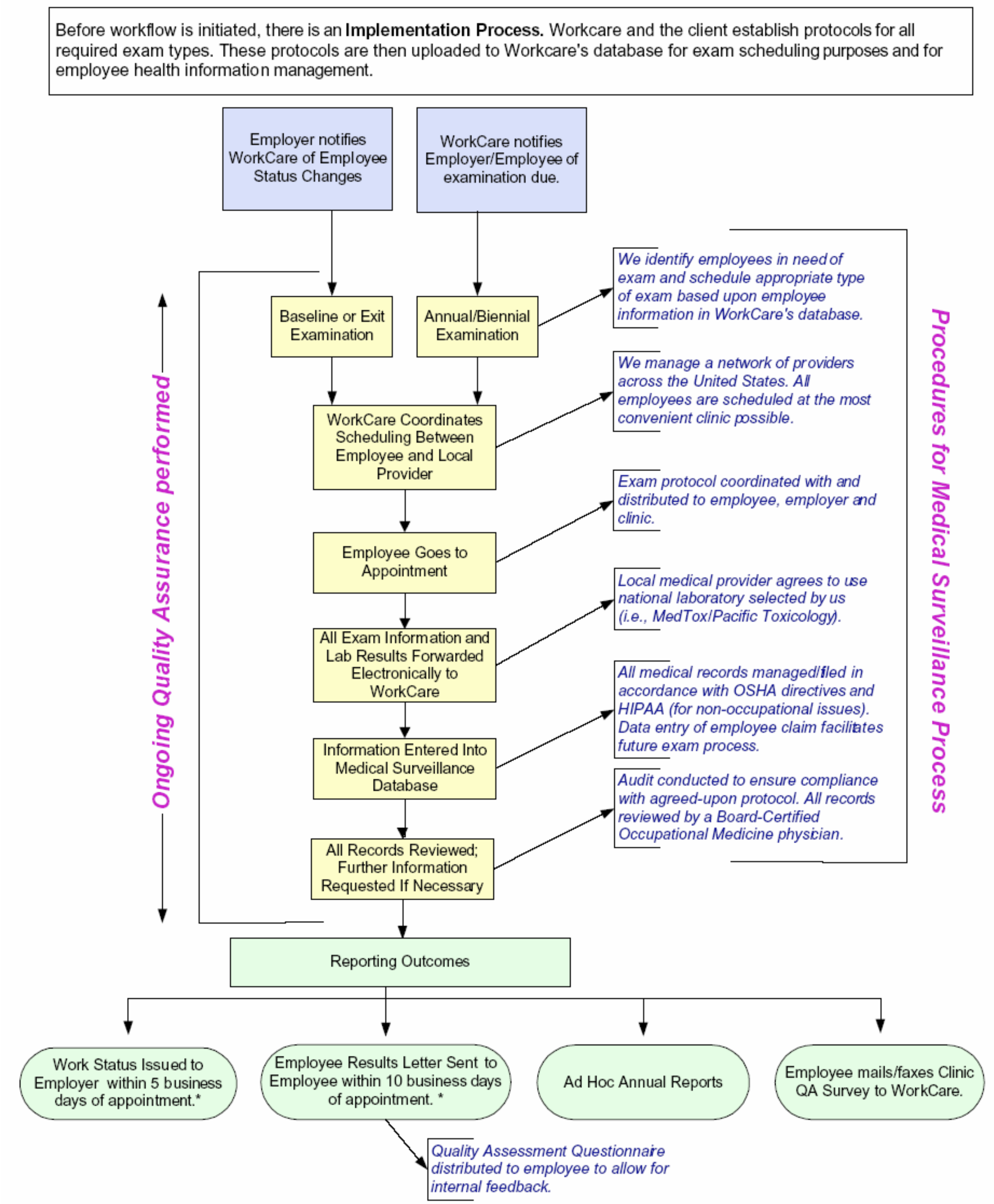
Address of Medical Center/Group: ____
____

Phone # of Medical Center/Group: ____

Physicians Name (Type or Print): ____

Signature of ***Examining Physician*** *(not nurse)* __________________________Date: ___________

WorkCare outline of Medical Surveillance Procedures:



* Reporting turnaround times may differ if client does not use WorkCare's scheduling services.

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Appendix H: CONTAMINATED WATER DIVING OPERATIONS

Diving in contaminated water poses a serious health risk to divers and topside personnel. All equipment and manning levels should be considered the recommended minimum approach to diving in contaminated environments and any applicable decompression required. Increased manning levels and additional equipment may be required for any diving in chemical, micro-biological, or radiological environments, including any water posing any thermal or toxic threat to the diver.

All diving procedures should follow guidance listed in the U.S. Navy publication Guidance for Diving in Contaminated Waters, Revision 1 (15 March 2008).

When planning diving in contaminated water AOR dive plans shall address:

- Expected types of contaminants;
- Identification methods and sources of contaminants
- Diver and topside contaminated water training;
- Levels of protection for divers and topside personnel (Equipment selection);
- Decontamination Procedures, including procedures incident to a diver casualty;
- Medical evaluation support and post dive monitoring;
- Hazardous waste minimization and disposal (If Applicable).

HAZARD EVALUATION AND IDENTIFICATION

Resources and methods for mitigating contaminated water conditions are available in the ADCI Consensus Standards, 6.2 Edition (2016.) Technical advice and testing procedures should be sought from a qualified industrial hygienist.

When considering potential contaminated water sites particular care should be taken when divers are expected to be in mud/sediment as that is where heavy metal contaminants accumulate. Additionally, rainfall and points of storm water or other discharges contribute to surface and vertical water contamination. Knowledge of industrial or agriculture activity in the surrounding local and upstream watershed is vital to making an informed hazard assessment.

Local, state and federal water management or environmental agencies and universities may be able to assist with identifying and addressing concerns with specific contaminants.

PERSONNEL TRAINING

- All personnel participating in contaminated water diving shall complete Hazardous Waste Operations and Emergency Response (HAZWOPER) training IAW 29 CFR 1910.120 and have adequate and specific training for the specific equipment, procedures and methods used.
- Dry suits
- PPE for topside and diving personnel
- Decon procedures

EQUIPMENT

PPE that protects the topside crew shall be selected commensurate with the toxins present.

See ADCI consensus standard section five for EPA selection guidelines. In no case shall topside personnel be dressed in less than outer protection (rain suit / water repellant coveralls) and face shield or goggles.

- Diving equipment protects the diver from skin, eye, and mucus membrane contact with the contaminated water and inspiration of contaminates.

An often overlooked hazard when diving in contaminated water is inspiration of contaminated water through the second stage regulator as water that leaks into the regulator body is atomized and mixed with the incoming air. It is for this reason that SCUBA shall not be used in any diving environment where contamination may be reasonably suspected.

- Surface supplied diving equipment with single exhaust valves have the same liability in contaminated water as SCUBA. Therefore, SSA equipment with double exhaust valves or a return line should be used commensurate with the risk.

Equipment used for contaminated water diving shall be maintained in exceptional condition with special care to the exhaust valves as deterioration may occur even during short dives that may require changing valves between dives. Operate, repair, and store diving equipment in accordance with the manufactures' recommendations.

- Dry suits shall be thoroughly inspected prior to use with special care given to zippers and seals. Do not use dry suits with dry rot, or apparent deterioration. Keep dry suits out of sunlight as it contributes to deterioration. Operate, repair, and store dry suits in accordance with the manufactures' recommendations.

GENERAL DECONTAMINATION PROCEDURES

AOR shall use a "zoned" approach to decontamination as described in ADCI consensus standard section five. Three zones shall be established that move the diver and crew from "dirty" to clean" in a progressive manner.

The diver will remain helmeted until fully decontaminated. Divers must be disciplined and directed in this manner as this is counter to all surface supplied training and practice where the helmet comes off first.

Personnel shall treat all dirty equipment with care and be attentive to avoid cross contamination. Attention to detail and use of a disciplined and methodical approach will ensure the protection of the dive crew.

DIVER CASUALTY

In the event of a diver casualty while diving in a contaminated water environment only general guidance can be given. Onsite supervisory personnel must make an informed decision that takes immediate life support into consideration over protection from potential long term health effects. All efforts to expedite a full or abbreviated decontamination shall be taken while responding to a diving casualty in a contaminated water environment.

MEDICAL MONITORING

Medical personnel shall be consulted when planning for diving in contaminated water to ensure proper precautions are taken and post-dive monitoring of divers is conducted. All employees performing work in contaminated environments shall be medically monitored – See Appendix G for AOR's medical surveillance program.

HAZARDOUS WASTE MINIMIZATION

Federal, state, or local regulations may require that residue collected in the decontamination process be collected and disposed of as hazardous waste. This will require prior coordination with local officials to ensure compliance. Every effort should be made to minimize the amount of waste generated consistent with personnel safety.

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Appendix I - GLOSSARY

Appendix I - GLOSSARY

ACFM (actual cubic feet per minute): Refers to the actual volume of gas supplied to a diver, bell, etc., at ambient pressure.

Activity Hazard Analysis (AHA): A method used to determine the steps of a specific job; outlines potential risks and hazards associated with the job and actions or procedures that will eliminate or minimize the risks.

Ambient Pressure: The surrounding pressure, at depth (actual, or simulated in a hyperbaric chamber) to which the diver, bell, etc., is subjected.

Ascent Times: The time interval between leaving the bottom when the dive is terminated and reaching the surface (1 ATA).

ATA (atmosphere absolute): Total pressure, including atmospheric, to which a diver, bell, etc., is subjected.

ATM (atmosphere): A unit of pressure equivalent to 14.7 psi or 760 mm of mercury.

Bail-out: An emergency situation in which a diver leaves bottom and comes directly to the surface, exceeding normal controlled ascent rates and missing scheduled decompression water stops.

Bail-out Bottle: See *Diver-Carried Reserve Breathing Gas*.

Bends: Alternative term for *Decompression Illness*.

BIBS: See *Built-in Breathing System*.

Bottom Time: The total elapsed time, measured in minutes, from the time the diver leaves the surface in descent to the time he begins ascent.

Breathing System: Device or apparatus for delivering respirable breathing mixture.

Built-in Breathing System: A device or apparatus for delivering respirable breathing mixture that is installed in a permanent fashion to the habitat.

Cleaned for Oxygen Service: Cleaning of equipment or system to ensure elimination of all hydrocarbons and other potentially dangerous contaminants when system is to be used in oxygen service. See also *Oxygen Cleaning*.

CNS: Central nervous system.

Compressor: A machine that raises air, or other gases, to a pressure above 1 ATM.

CPR (Cardiopulmonary Resuscitation): A combination or artificial respiration and artificial circulation.

Cylinder: A pressure ship for the storage of gases.

Decompression: Releasing from pressure or compression; following a specific decompression table or procedure during ascent; ascending in the water or experiencing pressure in the chamber.

Decompression Chamber (DDC): A deck chamber capable of controlled pressurization and depressurization; used for decompression, recompression, and treatment of diving injuries, submarine medicine or as a surface habitat for saturation divers.

Decompression Schedule: A time/depth profile with a specific bottom time and depth whose application is calculated to reduce the pressure on a diver to within safe limits.

Decompression Sickness (DCS): A condition that produces bubbles of gas in the blood or tissues of the diver during or after the ascent or other pressure reduction.

Decompression Table: A set of decompression schedules computed from a common protocol.

Dive Location: The ship or other structure from which dives are conducted and supported.

Dive Team: Divers and diver support personnel involved in a diving operation, including the diving supervisor.

Diver-Worn Equipment: Equipment required for the safety and wellbeing of the diver; worn by or attached to the diver while he is underwater.

Diving Operations: Any operation in which some type of diving or underwater work involves planned human exposure to increased pressure.

Dry Suit: A diving suit designed to exclude water from the surface of the body.

Exhaust Valve: A valve controlling the venting of gas from a DDC, divers helmet, suit, or buoyancy- changing equipment.

Embolism: See *Gas Embolism*.

FFW: Feet of Freshwater

FSW: Feet of Seawater

Harness: The approved combination of straps and fasteners used to attach equipment and umbilical to the diver.

Helium De-scrambler: An electronic device designed to render intelligible the words spoken in a helium hyperbaric environment.

Hyperbaric Conditions: Pressure conditions in excess of surface pressure.

Liveboating: The practice of supporting a diver from a Vessel that is underway.

Maximum Working Pressure: The maximum pressure to which a pressure containment device can be exposed under operating conditions.

MAWP (Maximum Allowable Working Pressure): See *Maximum Working Pressure*.

Mixed-gas Diving: A diving technique in which a diver is supplied with a gas mixture other than air for respiration.

NAVSCOLEOD: U.S. Naval School EOD

No-Decompression Diving: Diving that involves depths and times so that ascent to the surface can be made without water stops and/or subsequent chamber decompression.

Non-Return Valve (check valve): A one-way check valve installed in a gas system to permit gas flow in one direction only; all diving helmets must have a non-return valve at the gas supply inlet to prevent depressurization of the helmet and the resultant squeeze, should the gas supply be lost.

Over-bottom Pressure: That pressure above ambient that a breathing-gas supply must attain to the helmet/mask so that the diver will have a sufficient supply of gas.

Oxygen Cleaning: Special cleaning process for equipment in oxygen systems that removes all flammables.

Partial Pressure: That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

Pneumofathometer: A depth measuring device consisting of an opened-end hose fixed to the diver, with the surface-end connected to a gas supply and a pressure gauge.

PSI (pounds per square inch): An expression of pressure; 1 ATM = 14.7 psi.

PVHO (Pressure Vessel for Human Occupancy): See *Decompression Chamber*.

Rack Operator: Position implemented as needed on mixed-gas diving operations.

Relief Valve: A pressure-relieving device that prevents pressure from rising above a pre-set level.

Risk Assessment: A formal process of assessing and quantifying risk and probability with the desired result of developing action to reduce the perceived risk and probability.

SCUBA: A mode of diving that employs a Self-Contained Underwater Breathing Apparatus.

Standby Diver: Designated qualified diver at the dive location available to immediately assist the diver in the water.

Surface-Supplied Diving: A diving mode in which a diver receives breathing gas from a supply on the surface.

Treatment Tables: A depth, time, and breathing media profile designed to treat a diver for gas embolism or decompression sickness.

Umbilical: A hose bundle between the dive location and the diver and/or bell that supplies a lifeline, breathing gas, communications, power, and heat appropriate for the diving mode or conditions.

Valve: A device that starts, stops, or regulates the flow of fluids or gasses.

Volume Tank: A pressure ship connected to the outlet of a gas supply and used as a gas reservoir.

Weight Belt: A belt worn by a diver to achieve desired buoyancy.

Working Pressure: The pressure that a containment device is exposed to under normal operating conditions.

Work Site: An underwater location where work is performed.

Penetration dive: A dive that requires a diver to access an area that is both a physically confining space and one in which there is no direct access to the surface for recovery of the diver from the water by the tender.

Physically confining and limited access space: Any underwater space that would restrict the diver's ability to rotate himself head to toe, 180 degrees in any plane.

Direct access to the surface: A dive location where the diver can be easily pulled to the surface by a surface tender. This does not necessarily mean that there is not an obstruction on the surface directly above the diver during the dive, but that there is nothing to restrict the diver from being pulled back to the point of entry at the water surface by a topside tender.

Diver working around corners: A situation where the umbilical may become fouled or where line pull signals may become dissipated due to the dive site configuration creating an impossibility of a straight-line pull between the surface tender and the diver. When performing penetration diving, if the entrance to the penetration is underwater and not readily accessible from the surface, then the diver shall be tended at the entrance of the penetration by an in-water tender at all times. The purpose of the in-water tender is to tend the penetrating diver's umbilical and to assist should the diver require assistance in the event of a fouled umbilical or entrapment. In these conditions, the dive team must include an additional tender/diver.

2016

Appendix J: DESIGNATED DIVE SUPERVISOR LETTER

AOR Designated Diving Supervisor Certification Letter

______________________________is hereby designated AOR Diving Supervisor.

AOR having reviewed your qualification and training and hereby authorize you to supervise all diving operations on Air.

You are directed to conduct all diving operations in accordance with OSHA 29 CFR 1910 Subpart T, and US Army Corps of Engineers Publication 385-1-1, current revisions.

You are directed to maintain your knowledge of all diving, standard and emergency operating procedures as well as recompression procedures.

The AOR Safe Practices Manual will be on site for every diving evolution.

AOR Diving Program Manager________________________ Date_______________

AOR Project Manager ________________________ Date_______________

2016

Appendix K: OSHA 29 CFR 1910, Subpart T

Commercial Diving Operations

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); Sec. 107, Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333); Sec. 41, Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941); Secretary of Labor's Order No. 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 3–2000 (65 FR 50017), or 5–2002 (67 FR 65008) as applicable; 29 CFR part 1911.

Source: 42 FR 37668, July 22, 1977, unless otherwise noted.

General
§ 1910.401 Scope and application.
(a) *Scope.*
(1) This subpart (standard) applies to every place of employment within the waters of the United States, or within any State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, Guam, the Trust Territory of the Pacific Islands, Wake Island, Johnston Island, the Canal Zone, or within the Outer Continental Shelf lands as defined in the Outer Continental Shelf Lands Act (67 Stat. 462, 43 U.S.C. 1331), where diving and related support operations are performed.
(2) This standard applies to diving and related support operations conducted in connection with all types of work and employments, including general industry, construction, ship repairing, shipbuilding, shipbreaking and longshoring. However, this standard does not apply to any diving operation:
(i) Performed solely for instructional purposes, using open-circuit, compressed-air SCUBA and conducted within the no-decompression limits;
(ii) Performed solely for search, rescue, or related public safety purposes by or under the control of a governmental agency; or
(iii) Governed by 45 CFR part 46 (Protection of Human Subjects, U.S. Department of Health and Human Services) or equivalent rules or regulations established by another federal agency, which regulate research, development, or related purposes involving human subjects.
(iv) Defined as scientific diving and which is under the direction and control of a diving program containing at least the following elements:
(A) Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.
(B) Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices; and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.
(3) *Alternative requirements for recreational diving instructors and diving guides.* Employers of recreational diving instructors and diving guides are not required to comply with the decompression-chamber requirements specified by paragraphs (b)(2) and (c)(3)(iii) of §1910.423 and paragraph (b)(1) of §1910.426 when they meet all of the following conditions:
(i) The instructor or guide is engaging solely in recreational diving instruction or dive-guiding operations;
(ii) The instructor or guide is diving within the no-decompression limits in these operations;
(iii) The instructor or guide is using a nitrox breathing-gas mixture consisting of a high percentage of oxygen (more than 22% by volume) mixed with nitrogen;
(iv) The instructor or guide is using an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus (SCUBA); and
(v) The employer of the instructor or guide is complying with all requirements of Appendix C of this subpart.
(b) *Application in emergencies.* An employer may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation which is likely to cause death, serious physical harm, or major environmental damage, provided that the employer:
(1) Notifies the Area Director, Occupational Safety and Health Administration within 48 hours of the onset of the emergency situation indicating the nature of the emergency and extent of the deviation from the prescribed regulations; and
(2) Upon request from the Area Director, submits such information in writing.
(c) *Employer obligation.* The employer shall be responsible for compliance with:
(1) All provisions of this standard of general applicability; and
(2) All requirements pertaining to specific diving modes to the extent diving operations in such modes are

conducted.
[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982; 58 FR 35310, June 30, 1993; 69 FR 7363, Feb. 17, 2004]

§ 1910.402 Definitions.

As used in this standard, the listed terms are defined as follows:
Acfm: Actual cubic feet per minute.
ASME Code or equivalent:
ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII, or an equivalent code which the employer can demonstrate to be equally effective.
ATA: Atmosphere absolute.
Bell: An enclosed compartment, pressurized (closed bell) or unpressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations.
Bottom time: The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver begins ascent.
Bursting pressure: The pressure at which a pressure containment device would fail structurally
Cylinder: A pressure vessel for the storage of gases.
Decompression chamber: A pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system used to decompress divers and to treat decompression sickness.
Decompression sickness: A condition with a variety of symptoms which may result from gas or bubbles in the tissues of divers after pressure reduction.
Decompression table: A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.
Dive-guiding operations means leading groups of sports divers, who use an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, to local undersea diving locations for recreational purposes.
Dive location: A surface or vessel from which a diving operation is conducted.
Dive-location reserve breathing gas: A supply system of air or mixed-gas (as appropriate) at the dive location which is independent of the primary supply system and sufficient to support divers during the planned decompression.
Dive team: Divers and support employees involved in a diving operation, including the designated person-in-charge.
Diver: An employee working in water using underwater apparatus which supplies compressed breathing gas at the ambient pressure.
Diver-carried reserve breathing gas: A diver-carried supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by a standby diver.
Diving mode: A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).
Fsw: Feet of seawater (or equivalent static pressure head).
Heavy gear: Diver-worn deep-sea dress including helmet, breastplate, dry suit, and weighted shoes.
Hyperbaric conditions: Pressure conditions in excess of surface pressure.
In water stage: A suspended underwater platform which supports a diver in the water.
Liveboating: The practice of supporting a surfaced-supplied air or mixed gas diver from a vessel which is underway.
Mixed-gas diving: A diving mode in which the diver is supplied in the water with a breathing gas other than air.
No-decompression limits: The depth-time limits of the “no-decompression limits and repetitive dive group designation table for no-decompression air dives”, U.S. Navy Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.
Psi(g): Pounds per square inch (gauge).
Recreational diving instruction means training diving students in the use of recreational diving procedures and the safe operation of diving equipment, including an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, during dives.
Scientific diving means diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or

removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives.
SCUBA diving: A diving mode independent of surface supply in which the diver uses open circuit self-contained underwater breathing apparatus.
Standby diver: A diver at the dive location available to assist a diver in the water.
Surface-supplied air diving: A diving mode in which the diver in the water is supplied from the dive location with compressed air for breathing.
Treatment table: A depth-time and breathing gas profile designed to treat decompression sickness.
Umbilical: The composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions, and includes a safety line between the diver and the dive location.
Volume tank: A pressure vessel connected to the outlet of a compressor and used as an air reservoir.
Working pressure: The maximum pressure to which a pressure containment device may be exposed under standard operating conditions
[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982; 69 FR 7363, Feb. 17, 2004]

Personnel Requirements
§ 1910.410   Qualifications of dive team.
(a) *General.*
(1) Each dive team member shall have the experience or training necessary to perform assigned tasks in a safe and healthful manner.
(2) Each dive team member shall have experience or training in the following:
(i) The use of tools, equipment and systems relevant to assigned tasks;
(ii) Techniques of the assigned diving mode: and
(iii) Diving operations and emergency procedures.
(3) All dive team members shall be trained in cardiopulmonary resuscitation and first aid (American Red Cross standard course or equivalent).
(4) Dive team members who are exposed to or control the exposure of others to hyperbaric conditions shall be trained in diving-related physics and physiology.
(b) *Assignments.* (1) Each dive team member shall be assigned tasks in accordance with the employee's experience or training, except that limited additional tasks may be assigned to an employee undergoing training provided that these tasks are performed under the direct supervision of an experienced dive team member.
(2) The employer shall not require a dive team member to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.
(3) The employer shall not permit a dive team member to dive or be otherwise exposed to hyperbaric conditions for the duration of any temporary physical impairment or condition which is known to the employer and is likely to affect adversely the safety or health of a dive team member.
(c) *Designated person-in-charge.* (1) The employer or an employee designated by the employer shall be at the dive location in charge of all aspects of the diving operation affecting the safety and health of dive team members.
(2) The designated person-in-charge shall have experience and training in the conduct of the assigned diving operation.
General Operations Procedures
§ 1910.420   Safe practices manual.
(a) *General.* The employer shall develop and maintain a safe practices manual which shall be made available at the dive location to each dive team member.
(b) *Contents.*
(1) The safe practices manual shall contain a copy of this standard and the employer's policies for implementing the requirements of this standard.
(2) For each diving mode engaged in, the safe practices manual shall include:
(i) Safety procedures and checklists for diving operations;
(ii) Assignments and responsibilities of the dive team members;
(iii) Equipment procedures and checklists; and
(iv) Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.
[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984]

§ 1910.421   Pre-dive procedures.

(a) *General.* The employer shall comply with the following requirements prior to each diving operation, unless otherwise specified.
(b) *Emergency aid.* A list shall be kept at the dive location of the telephone or call numbers of the following:
(1) An operational decompression chamber (if not at the dive location);
(2) Accessible hospitals;
(3) Available physicians;
(4) Available means of transportation; and
(5) The nearest U.S. Coast Guard Rescue Coordination Center.
(c) *First aid supplies.*
(1) A first aid kit appropriate for the diving operation and approved by a physician shall be available at the dive location.
(2) When used in a decompression chamber or bell, the first aid kit shall be suitable for use under hyperbaric conditions.
(3) In addition to any other first aid supplies, an American Red Cross standard first aid handbook or equivalent, and a bag-type manual resuscitator with transparent mask and tubing shall be available at the dive location.
(d) *Planning and assessment.* Planning of a diving operation shall include an assessment of the safety and health aspects of the following:
(1) Diving mode;
(2) Surface and underwater conditions and hazards;
(3) Breathing gas supply (including reserves);
(4) Thermal protection;
(5) Diving equipment and systems;
(6) Dive team assignments and physical fitness of dive team members (including any impairment known to the employer);
(7) Repetitive dive designation or residual inert gas status of dive team members;
(8) Decompression and treatment procedures (including altitude corrections); and
(9) Emergency procedures.
(e) *Hazardous activities.* To minimize hazards to the dive team, diving operations shall be coordinated with other activities in the vicinity which are likely to interfere with the diving operation.
(f) *Employee briefing.*
(1) Dive team members shall be briefed on:
(i) The tasks to be undertaken;
(ii) Safety procedures for the diving mode;
(iii) Any unusual hazards or environmental conditions likely to affect the safety of the diving operation; and
(iv) Any modifications to operating procedures necessitated by the specific diving operation.
(2) Prior to making individual dive team member assignments, the employer shall inquire into the dive team member's current state of physical fitness, and indicate to the dive team member the procedure for reporting physical problems or adverse physiological effects during and after the dive.
(g) *Equipment inspection.* The breathing gas supply system including reserve breathing gas supplies, masks, helmets, thermal protection, and bell handling mechanism (when appropriate) shall be inspected prior to each dive.
(h) *Warning signal.* When diving from surfaces other than vessels in areas capable of supporting marine traffic, a rigid replica of the international code flag "A" at least one meter in height shall be displayed at the dive location in a manner which allows all-round visibility, and shall be illuminated during night diving operations.
[42 FR 37668, July 22, 1977, as amended at 47 FR 14706, Apr. 6, 1982; 54 FR 24334, June 7, 1989]

§ 1910.422 Procedures during dive.
(a) *General.* The employer shall comply with the following requirements which are applicable to each diving operation unless otherwise specified.
(b) *Water entry and exit.*
(1) A means capable of supporting the diver shall be provided for entering and exiting the water.
(2) The means provided for exiting the water shall extend below the water surface.
(3) A means shall be provided to assist an injured diver from the water or into a bell.
(c) *Communications.*
(1) An operational two-way voice communication system shall be used between:
(i) Each surface-supplied air or mixed-gas diver and a dive team member at the dive location or bell (when provided or required); and

(ii) The bell and the dive location.
(2) An operational, two-way communication system shall be available at the dive location to obtain emergency assistance.
(d) *Decompression tables.* Decompression, repetitive, and no-decompression tables (as appropriate) shall be at the dive location.
(e) *Dive profiles.* A depth-time profile, including when appropriate any breathing gas changes, shall be maintained for each diver during the dive including decompression.
(f) *Hand-held power tools and equipment.*
(1) Hand-held electrical tools and equipment shall be de-energized before being placed into or retrieved from the water.
(2) Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.
(g) *Welding and burning.*
(1) A current supply switch to interrupt the current flow to the welding or burning electrode shall be:
(i) Tended by a dive team member in voice communication with the diver performing the welding or burning; and
(ii) Kept in the open position except when the diver is welding or burning.
(2) The welding machine frame shall be grounded.
(3) Welding and burning cables, electrode holders, and connections shall be capable of carrying the maximum current required by the work, and shall be properly insulated.
(4) Insulated gloves shall be provided to divers performing welding and burning operations.
(5) Prior to welding or burning on closed compartments, structures or pipes, which contain a flammable vapor or in which a flammable vapor may be generated by the work, they shall be vented, flooded, or purged with a mixture of gases which will not support combustion.
(h) *Explosives.*
(1) Employers shall transport, store, and use explosives in accordance with this section and the applicable provisions of §1910.109 and §1926.912 of Title 29 of the Code of Federal Regulations.
(2) Electrical continuity of explosive circuits shall not be tested until the diver is out of the water.
(3) Explosives shall not be detonated while the diver is in the water.
(i) *Termination of dive.* The working interval of a dive shall be terminated when:
(1) A diver requests termination;
(2) A diver fails to respond correctly to communications or signals from a dive team member;
(3) Communications are lost and can not be quickly re-established between the diver and a dive team member at the dive location, and between the designated person-in-charge and the person controlling the vessel in live boating operations; or
(4) A diver begins to use diver-carried reserve breathing gas or the dive-location reserve breathing gas.

§ 1910.423 Post-dive procedures.
(a) *General.* The employer shall comply with the following requirements which are applicable after each diving operation, unless otherwise specified.
(b) *Precautions.*
(1) After the completion of any dive, the employer shall:
(i) Check the physical condition of the diver;
(ii) Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness;
(iii) Advise the diver of the location of a decompression chamber which is ready for use; and
(iv) Alert the diver to the potential hazards of flying after diving.
(2) For any dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas as a breathing mixture, the employer shall instruct the diver to remain awake and in the vicinity of the decompression chamber which is at the dive location for at least one hour after the dive (including decompression or treatment as appropriate).
(c) *Recompression capability.*
(1) A decompression chamber capable of recompressing the diver at the surface to a minimum of 165 fsw (6 ATA) shall be available at the dive location for:
(i) Surface-supplied air diving to depths deeper than 100 fsw and shallower than 220 fsw;
(ii) Mixed gas diving shallower than 300 fsw; or
(iii) Diving outside the no-decompression limits shallower than 300 fsw.
(2) A decompression chamber capable of recompressing the
diver at the surface to the maximum depth of the dive shall be available at the dive location for dives deeper

than 300 fsw.
(3) The decompression chamber shall be:
(i) Dual-lock;
(ii) Multiplace; and
(iii) Located within 5 minutes of the dive location.
(4) The decompression chamber shall be equipped with:
(i) A pressure gauge for each pressurized compartment designed for human occupancy;
(ii) A built-in-breathing-system with a minimum of one mask per occupant;
(iii) A two-way voice communication system between occupants and a dive team member at the dive location;
(iv) A viewport; and
(v) Illumination capability to light the interior.
(5) Treatment tables, treatment gas appropriate to the diving mode, and sufficient gas to conduct treatment shall be available at the dive location.
(6) A dive team member shall be available at the dive location during and for at least one hour after the dive to operate the decompression chamber (when required or provided).
(d) *Record of dive.*
(1) The following information shall be recorded and maintained for each diving operation:
(i) Names of dive team members including designated person-in-charge;
(ii) Date, time, and location;
(iii) Diving modes used;
(iv) General nature of work performed;
(v) Approximate underwater and surface conditions (visibility, water temperature and current); and
(vi) Maximum depth and bottom time for each diver.
(2) For each dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas, the following additional information shall be recorded and maintained:
(i) Depth-time and breathing gas profiles;
(ii) Decompression table designation (including modification); and
(iii) Elapsed time since last pressure exposure if less than 24 hours or repetitive dive designation for each diver.
(3) For each dive in which decompression sickness is suspected or symptoms are evident, the following additional information shall be recorded and maintained:
(i) Description of decompression sickness symptoms (including depth and time of onset); and
(ii) Description and results of treatment.
(e) *Decompression procedure assessment.* The employer shall:
(1) Investigate and evaluate each incident of decompression sickness based on the recorded information, consideration of the past performance of decompression table used, and individual susceptibility;
(2) Take appropriate corrective action to reduce the probability of recurrence of decompression sickness; and
(3) Prepare a written evaluation of the decompression procedure assessment, including any corrective action taken, within 45 days of the incident of decompression sickness.
[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984]

Specific Operations Procedures
§ 1910.424 SCUBA diving
(a) *General.* Employers engaged in SCUBA diving shall comply with the following requirements, unless otherwise specified.
(b) *Limits.* SCUBA diving shall not be conducted:
(1) At depths deeper than 130 fsw;
(2) At depths deeper than 100 fsw or outside the no-decompression limits unless a decompression chamber is ready for use;
(3) Against currents exceeding one (1) knot unless line-tended; or
(4) In enclosed or physically confining spaces unless line-tended.
(c) *Procedures.*
(1) A standby diver shall be available while a diver is in the water.
(2) A diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations.
(3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(4) A diver-carried reserve breathing gas supply shall be provided for each diver consisting of:
(i) A manual reserve (J valve); or
(ii) An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus.
(5) The valve of the reserve breathing gas supply shall be in the closed position prior to the dive.

§ 1910.425 Surface-supplied air diving.
(a) *General.* Employers engaged in surface-supplied air diving shall comply with the following requirements, unless otherwise specified.
(b) *Limits.*
(1) Surface-supplied air diving shall not be conducted at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw.
(2) A decompression chamber shall be ready for use at the dive location for any dive outside the no-decompression limits or deeper than 100 fsw.
(3) A bell shall be used for dives with an in water decompression time greater than 120 minutes, except when heavy gear is worn or diving is conducted in physically confining spaces.
(c) *Procedures.*
(1) Each diver shall be continuously tended while in the water.
(2) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
(3) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.
(4) For dives deeper than 100 fsw or outside the no-decompression limits:
(i) A separate dive team member shall tend each diver in the water;
(ii) A standby diver shall be available while a diver is in the water;
(iii) A diver-carried reserve breathing gas supply shall be provided for each diver except when heavy gear is worn; and
(iv) A dive-location reserve breathing gas supply shall be provided.
(5) For heavy-gear diving deeper than 100 fsw or outside the no-decompression limits:
(i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the standby diver.
(ii) An in water stage shall be provided to divers in the water.
(6) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided whenever the diver is prevented by the configuration of the dive area from ascending directly to the surface.

§ 1910.426 Mixed-gas diving.
(a) *General.* Employers engaged in mixed-gas diving shall comply with the following requirements, unless otherwise specified.
(b) *Limits.* Mixed-gas diving shall be conducted only when:
(1) A decompression chamber is ready for use at the dive location; and
(i) A bell is used at depths greater than 220 fsw or when the dive involves in water decompression time of greater than 120 minutes, except when heavy gear is worn or when diving in physically confining spaces; or
(ii) A closed bell is used at depths greater than 300 fsw, except when diving is conducted in physically confining spaces.
(c) *Procedures.*
(1) A separate dive team member shall tend each diver in the water.
(2) A standby diver shall be available while a diver is in the water.
(3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
(4) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.
(5) Each diving operation shall have a dive-location reserve breathing gas supply.
(6) When heavy gear is worn:
(i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the standby diver; and
(ii) An in water stage shall be provided to divers in the water.
(7) An in water stage shall be provided for divers without access to a bell for dives deeper than 100 fsw or outside the no-decompression limits.

(8) When a closed bell is used, one dive team member in the bell shall be available and tend the diver in the water.
(9) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided for each diver:
(i) Diving deeper than 100 fsw or outside the no-decompression limits; or
(ii) Prevented by the configuration of the dive area from directly ascending to the surface.

§ 1910.427 Live boating.
(a) *General.* Employers engaged in diving operations involving live boating shall comply with the following requirements.
(b) *Limits.* Diving operations involving live boating shall not be conducted:
(1) With an in water decompression time of greater than 120 minutes;
(2) Using surface-supplied air at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw;
(3) Using mixed gas at depths greater than 220 fsw;
(4) In rough seas which significantly impede diver mobility or work function; or
(5) In other than daylight hours.
(c) *Procedures.* (1) The propeller of the vessel shall be stopped before the diver enters or exits the water.
(2) A device shall be used which minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.
(3) Two-way voice communication between the designated person-in-charge and the person controlling the vessel shall be available while the diver is in the water.
(4) A standby diver shall be available while a diver is in the water.
(5) A diver-carried reserve breathing gas supply shall be carried by each diver engaged in live boating operations.
Equipment Procedures and Requirements

§ 1910.430 Equipment.
(a) *General.*
(1) All employers shall comply with the following requirements, unless otherwise specified.
(2) Each equipment modification, repair, test, calibration or maintenance service shall be recorded by means of a tagging or logging system, and include the date and nature of work performed, and the name or initials of the person performing the work.
(b) *Air compressor system.*
(1) Compressors used to supply air to the diver shall be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.
(2) Air compressor intakes shall be located away from areas containing exhaust or other contaminants.
(3) Respirable air supplied to a diver shall not contain:
(i) A level of carbon monoxide (CO) greater than 20 p/m;
(ii) A level of carbon dioxide (CO_2) greater than 1,000 p/m;
(iii) A level of oil mist greater than 5 milligrams per cubic meter; or
(iv) A noxious or pronounced odor.
(4) The output of air compressor systems shall be tested for air purity every 6 months by means of samples taken at the connection to the distribution system, except that non-oil lubricated compressors need not be tested for oil mist.
(c) *Breathing gas supply hoses.* (1) Breathing gas supply hoses shall:
(i) Have a working pressure at least equal to the working pressure of the total breathing gas system;
(ii) Have a rated bursting pressure at least equal to 4 times the working pressure;
(iii) Be tested at least annually to 1.5 times their working pressure; and
(iv) Have their open ends taped, capped or plugged when not in use.
(2) Breathing gas supply hose connectors shall:
(i) Be made of corrosion-resistant materials;
(ii) Have a working pressure at least equal to the working pressure of the hose to which they are attached; and
(iii) Be resistant to accidental disengagement.
(3) Umbilicals shall:
(i) Be marked in 10-ft. increments to 100 feet beginning at the diver's end, and in 50 ft. increments thereafter;
(ii) Be made of kink-resistant materials; and
(iii) Have a working pressure greater than the pressure equivalent to the maximum depth of the dive (relative

to the supply source) plus 100 psi.
(d) *Buoyancy control.*
(1) Helmets or masks connected directly to the dry suit or other buoyancy-changing equipment shall be equipped with an exhaust valve.
(2) A dry suit or other buoyancy-changing equipment not directly connected to the helmet or mask shall be equipped with an exhaust valve.
(3) When used for SCUBA diving, a buoyancy compensator shall have an inflation source separate from the breathing gas supply.
(4) An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manually activated inflation source independent of the breathing supply, an oral inflation device, and an exhaust valve shall be used for SCUBA diving.
(e) *Compressed gas cylinders.* Compressed gas cylinders shall:
(1) Be designed, constructed and maintained in accordance with the applicable provisions of 29 CFR 1910.101 and 1910.169 through 1910.171.
(2) Be stored in a ventilated area and protected from excessive heat;
(3) Be secured from falling; and
(4) Have shut-off valves recessed into the cylinder or protected by a cap, except when in use or manifolded, or when used for SCUBA diving.
(f) *Decompression chambers.* (
1) Each decompression chamber manufactured after the effective date of this standard, shall be built and maintained in accordance with the ASME Code or equivalent.
(2) Each decompression chamber manufactured prior to the effective date of this standard shall be maintained in conformity with the code requirements to which it was built, or equivalent.
(3) Each decompression chamber shall be equipped with:
(i) Means to maintain the atmosphere below a level of 25
percent oxygen by volume;
(ii) Mufflers on intake and exhaust lines, which shall be regularly inspected and maintained;
(iii) Suction guards on exhaust line openings; and
(iv) A means for extinguishing fire, and shall be maintained to minimize sources of ignition and combustible material.
(g) *Gauges and timekeeping devices.* (
1) Gauges indicating diver depth which can be read at the dive location shall be used for all dives except SCUBA.
(2) Each depth gauge shall be deadweight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than two percent (2 percent) of full scale between any two equivalent gauges.
(3) A cylinder pressure gauge capable of being monitored by the diver during the dive shall be worn by each SCUBA diver.
(4) A timekeeping device shall be available at each dive location.
(h) *Masks and helmets.*
(1) Surface-supplied air and mixed-gas masks and helmets shall have:
(i) A non-return valve at the attachment point between helmet or mask and hose which shall close readily and positively; and
(ii) An exhaust valve.
(2) Surface-supplied air masks and helmets shall have a minimum ventilation rate capability of 4.5 Acfm at any depth at which they are operated or the capability of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.
(i) *Oxygen safety.*
(1) Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed for oxygen service.
(2) Components (except umbilicals) exposed to oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be cleaned of flammable materials before use.
(3) Oxygen systems over 125 psig and compressed air systems over 500 psig shall have slow-opening shut-off valves.
(j) *Weights and harnesses.*
(1) Except when heavy gear is worn, divers shall be equipped with a weight belt or assembly capable of quick release.
(2) Except when heavy gear is worn or in SCUBA diving, each diver shall wear a safety harness with:

(i) A positive buckling device;
(ii) An attachment point for the umbilical to prevent strain on the mask or helmet; and
(iii) A lifting point to distribute the pull force of the line over the diver's body.
[39 FR 23502, June 27, 1974, as amended at 49 FR 18295, Apr. 30, 1984; 51 FR 33033, Sept. 18, 1986]

Recordkeeping
§ 1910.440 Recordkeeping requirements.
(a)(1) [Reserved]
(2) The employer shall record the occurrence of any diving-related injury or illness which requires any dive team member to be hospitalized for 24 hours or more, specifying the circumstances of the incident and the extent of any injuries or illnesses.
(b) *Availability of records.*
(1) Upon the request of the Assistant Secretary of Labor for Occupational Safety and Health, or the Director, National Institute for Occupational Safety and Health, Department of Health and Human Services of their designees, the employer shall make available for inspection and copying any record or document required by this standard.
(2) Records and documents required by this standard shall be provided upon request to employees, designated representatives, and the Assistant Secretary in accordance with 29 CFR 1910.1020 (a)–(e) and (g)–(i). Safe practices manuals (§1910.420), depth-time profiles (§1910.422), recordings of dives (§1910.423), decompression procedure assessment evaluations (§1910.423), and records of hospitalizations (§1910.440) shall be provided in the same manner as employee exposure records or analyses using exposure or medical records. Equipment inspections and testing records which pertain to employees (§1910.430) shall also be provided upon request to employees and their designated representatives.
(3) Records and documents required by this standard shall be retained by the employer for the following period:
(i) Dive team member medical records (physician's reports) (§1910.411)—5 years;
(ii) Safe practices manual (§1910.420)—current document only;
(iii) Depth-time profile (§1910.422)—until completion of the recording of dive, or until completion of decompression procedure assessment where there has been an incident of decompression sickness;
(iv) Recording of dive (§1910.423)—1 year, except 5 years where there has been an incident of decompression sickness;
(v) Decompression procedure assessment evaluations (§1910.423)—5 years;
(vi) Equipment inspections and testing records (§1910.430)—current entry or tag, or until equipment is withdrawn from service;
(vii) Records of hospitalizations (§1910.440)—5 years.
(4) After the expiration of the retention period of any record required to be kept for five (5) years, the employer shall forward such records to the National Institute for Occupational Safety and Health, Department of Health and Human Services. The employer shall also comply with any additional requirements set forth at 29 CFR 1910.20(h).
(5) In the event the employer ceases to do business:
(i) The successor employer shall receive and retain all dive and employee medical records required by this standard; or
(ii) If there is no successor employer, dive and employee medical records shall be forwarded to the National Institute for Occupational Safety and Health, Department of Health and Human Services.
[42 FR 37668, July 22, 1977, as amended at 45 FR 35281, May 23, 1980; 47 FR 14706, Apr. 6, 1982; 51 FR 34562, Sept. 29, 1986; 61 FR 9242, Mar. 7, 1996; 71 FR 16672, Apr. 3, 2006]

Appendix A to Subpart T to Part 1910—Examples of Conditions Which May Restrict or Limit Exposure to Hyperbaric Conditions

The following disorders may restrict or limit occupational exposure to hyperbaric conditions depending on severity, presence of residual effects, response to therapy, number of occurrences, diving mode, or degree and duration of isolation.

History of seizure disorder other than early febrile convulsions

Malignancies (active) unless treated and without recurrence for 5 yrs. Chronic inability to equalize sinus and/or middle ear pressure. Cystic or cavitary disease of the lungs. Impaired organ function caused by alcohol or drug use. Conditions requiring continuous medication for control (e.g., antihistamines, steroids, barbiturates, mood altering drugs, or insulin).

Meniere's disease

Hemoglobinopathies

Obstructive or restrictive lung disease

Vestibular end organ destruction

Pneumothorax

Cardiac abnormalities (e.g., pathological heart block, valvular disease, intraventricular conduction defects other than isolated right bundle branch block, angina pectoris, arrhythmia, coronary artery disease).

Juxta-articular osteonecrosis

Appendix B to Subpart T to Part 1910—Guidelines for Scientific Diving

This appendix contains guidelines that will be used in conjunction with §1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

1. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operations.
2. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and, therefore, are scientists or scientists in training.

[50 FR 1050, Jan. 9, 1985]

Appendix C to Subpart T to Part 1910—Alternative Conditions Under §1910.401(a)(3) for Recreational Diving Instructors and Diving Guides (Mandatory)

Paragraph (a)(3) of §1910.401 specifies that an employer of recreational diving instructors and diving guides (hereafter, “divers” or “employees”) who complies with all of the conditions of this appendix need not provide a decompression chamber for these divers as required under §§1910.423(b)(2) or (c)(3) or 1910.426(b)(1).

1. Equipment Requirements for Rebreathers

(a) The employer must ensure that each employee operates the rebreather (i.e*.,* semi-closed-circuit and closed-circuit self-contained underwater breathing apparatuses (hereafter, “SCUBAs”)) according to the rebreather manufacturer's instructions.

(b) The employer must ensure that each rebreather has a counter lung that supplies a sufficient volume of breathing gas to their divers to sustain the divers' respiration rates, and contains a baffle system and/or other moisture separating system that keeps moisture from entering the scrubber.

(c) The employer must place a moisture trap in the breathing loop of the rebreather, and ensure that:

(i) The rebreather manufacturer approves both the moisture trap and its location in the breathing loop; and

(ii) Each employee uses the moisture trap according to the rebreather manufacturer's instructions.

(d) The employer must ensure that each rebreather has a continuously functioning moisture sensor, and that:

(i) The moisture sensor connects to a visual (*e.g.,* digital, graphic, analog) or auditory (*e.g.,* voice, pure tone) alarm that is readily detectable by the diver under the diving conditions in which the diver operates, and warns the diver of moisture in the breathing loop in sufficient time to terminate the dive and return safely to the surface; and

(ii) Each diver uses the moisture sensor according to the rebreather manufacturer's instructions.

(e) The employer must ensure that each rebreather contains a continuously functioning CO_2sensor in the breathing loop, and that:

(i) The rebreather manufacturer approves the location of the CO_2sensor in the breathing loop;

(ii) The CO_2sensor is integrated with an alarm that operates in a visual (e.g*.,* digital, graphic, analog) or auditory (e.g*.,* voice, pure tone) mode that is readily detectable by each diver under the diving conditions in

which the diver operates; and
(iii) The CO_2alarm remains continuously activated when the inhaled CO_2level reaches and exceeds 0.005 atmospheres absolute (ATA).
(f) Before each day's diving operations, and more often when necessary, the employer must calibrate the CO_2sensor according to the sensor manufacturer's instructions, and ensure that:
(i) The equipment and procedures used to perform this calibration are accurate to within 10% of a CO_2concentration of 0.005 ATA or less;
(ii) The equipment and procedures maintain this accuracy as required by the sensor manufacturer's instructions; and
(iii) The calibration of the CO_2sensor is accurate to within 10% of a CO_2concentration of 0.005 ATA or less.
(g) The employer must replace the CO_2sensor when it fails to meet the accuracy requirements specified in paragraph 1
(f)(iii) of this appendix, and ensure that the replacement CO_2sensor meets the accuracy requirements specified in paragraph 1(f)(iii) of this appendix before placing the rebreather in operation.
(h) As an alternative to using a continuously functioning CO_2sensor, the employer may use a schedule for replacing CO_2-sorbent material provided by the rebreather manufacturer. The employer may use such a schedule only when the rebreather manufacturer has developed it according to the canister-testing protocol specified below in Condition 11, and must use the canister within the temperature range for which the manufacturer conducted its scrubber canister tests following that protocol. Variations above or below the range are acceptable only after the manufacturer adds that lower or higher temperature to the protocol.
(i) When using CO_2-sorbent replacement schedules, the employer must ensure that each rebreather uses a manufactured (*i.e.,* commercially pre-packed), disposable scrubber cartridge containing a CO_2-sorbent material that:
(i) Is approved by the rebreather manufacturer;
(ii) Removes $CO_2$from the diver's exhaled gas; and
(iii) Maintains the CO_2level in the breathable gas (*i.e.,* the gas that a diver inhales directly from the regulator) below a partial pressure of 0.01 ATA.
(j) As an alternative to manufactured, disposable scrubber cartridges, the employer may fill CO_2scrubber cartridges manually with CO_2-sorbent material when:
(i) The rebreather manufacturer permits manual filling of scrubber cartridges;
(ii) The employer fills the scrubber cartridges according to the rebreather manufacturer's instructions;
(iii) The employer replaces the CO_2-sorbent material using a replacement schedule developed under paragraph 1(h) of this appendix; and
(iv) The employer demonstrates that manual filling meets the requirements specified in paragraph 1(i) of this appendix.
(k) The employer must ensure that each rebreather has an information module that provides:
(i) A visual (e.g*.,* digital, graphic, analog) or auditory (e.g*.,* voice, pure tone) display that effectively warns the diver of solenoid failure (when the rebreather uses solenoids) and other electrical weaknesses or failures (e.g*.,* low battery voltage);
(ii) For a semi-closed circuit rebreather, a visual display for the partial pressure of CO_2, or deviations above and below a preset CO_2partial pressure of 0.005 ATA; and
(iii) For a closed-circuit rebreather, a visual display for: partial pressures of $O_2$and CO_2, or deviations above and below a preset CO_2partial pressure of 0.005 ATA and a preset O_2partial pressure of 1.40 ATA or lower; gas temperature in the breathing loop; and water temperature.
(l) Before each day's diving operations, and more often when necessary, the employer must ensure that the electrical power supply and electrical and electronic circuits in each rebreather are operating as required by the rebreather manufacturer's instructions.
2. Special Requirements for Closed-Circuit Rebreathers
(a) The employer must ensure that each closed-circuit rebreather uses supply-pressure sensors for the $O_2$and diluent (i.e*.,* air or nitrogen) gases and continuously functioning sensors for detecting temperature in the inhalation side of the gas-loop and the ambient water.
(b) The employer must ensure that:
(i) At least two O_2sensors are located in the inhalation side of the breathing loop; and
(ii) The O_2sensors are: functioning continuously; temperature compensated; and approved by the rebreather manufacturer.
(c) Before each day's diving operations, and more often when necessary, the employer must calibrate O_2sensors as required by the sensor manufacturer's instructions. In doing so, the employer must:
(i) Ensure that the equipment and procedures used to perform the calibration are accurate to within 1% of the O_2fraction by volume;

(ii) Maintain this accuracy as required by the manufacturer of the calibration equipment;
(iii) Ensure that the sensors are accurate to within 1% of the O_2 fraction by volume;
(iv) Replace O_2 sensors when they fail to meet the accuracy requirements specified in paragraph 2(c)(iii) of this appendix; and
(v) Ensure that the replacement O_2 sensors meet the accuracy requirements specified in paragraph 2(c)(iii) of this appendix before placing a rebreather in operation.
(d) The employer must ensure that each closed-circuit rebreather has:
(i) A gas-controller package with electrically operated solenoid O_2-supply valves;
(ii) A pressure-activated regulator with a second-stage diluent-gas addition valve;
(iii) A manually operated gas-supply bypass valve to add O_2 or diluent gas to the breathing loop; and
(iv) Separate O_2 and diluent-gas cylinders to supply the breathing-gas mixture.
3. O_2 Concentration in the Breathing Gas
The employer must ensure that the fraction of O_2 in the nitrox breathing-gas mixture:
(a) Is greater than the fraction of O_2 in compressed air (*i.e.,* exceeds 22% by volume);
(b) For open-circuit SCUBA, never exceeds a maximum fraction of breathable O_2 of 40% by volume or a maximum O_2 partial pressure of 1.40 ATA, whichever exposes divers to less O_2; and
(c) For a rebreather, never exceeds a maximum O_2 partial pressure of 1.40 ATA.
4. Regulating O_2 Exposures and Diving Depth
(a) Regarding O_2 exposure, the employer must:
(i) Ensure that the exposure of each diver to partial pressures of O_2 between 0.60 and 1.40 ATA does not exceed the 24-hour single-exposure time limits specified either by the 2001 National Oceanic and Atmospheric Administration Diving Manual (the “2001 NOAA Diving Manual”), or by the report entitled “Enriched Air Operations and Resource Guide” published in 1995 by the Professional Association of Diving Instructors (known commonly as the “1995 DSAT Oxygen Exposure Table”); and
(ii) Determine a diver's O_2-exposure duration using the diver's maximum O_2 exposure (partial pressure of O_2) during the dive and the total dive time (i.e*.,* from the time the diver leaves the surface until the diver returns to the surface).
(b) Regardless of the diving equipment used, the employer must ensure that no diver exceeds a depth of 130 feet of sea water (“fsw”) or a maximum O_2 partial pressure of 1.40 ATA, whichever exposes the diver to less O_2.
5. Use of No-Decompression Limits
(a) For diving conducted while using nitrox breathing-gas mixtures, the employer must ensure that each diver remains within the no-decompression limits specified for single and repetitive air diving and published in the 2001 NOAA Diving Manual or the report entitled “Development and Validation of No-Stop Decompression Procedures for Recreational Diving: The DSAT Recreational Dive Planner,” published in 1994 by Hamilton Research Ltd. (known commonly as the “1994 DSAT No-Decompression Tables”).
(b) An employer may permit a diver to use a dive-decompression computer designed to regulate decompression when the dive-decompression computer uses the no-decompression limits specified in paragraph 5(a) of this appendix, and provides output that reliably represents those limits.
6. Mixing and Analyzing the Breathing Gas
(a) The employer must ensure that:
(i) Properly trained personnel mix nitrox-breathing gases, and that nitrogen is the only inert gas used in the breathing-gas mixture; and
(ii) When mixing nitrox-breathing gases, they mix the appropriate breathing gas before delivering the mixture to the breathing-gas cylinders, using the continuous-flow or partial-pressure mixing techniques specified in the 2001 NOAA Diving Manual, or using a filter-membrane system.
(b) Before the start of each day's diving operations, the employer must determine the O_2 fraction of the breathing-gas mixture using an O_2 analyzer. In doing so, the employer must:
(i) Ensure that the O_2 analyzer is accurate to within 1% of the O_2 fraction by volume.
(ii) Maintain this accuracy as required by the manufacturer of the analyzer.
(c) When the breathing gas is a commercially supplied nitrox breathing-gas mixture, the employer must ensure that the O_2 meets the medical USP specifications (Type I, Quality Verification Level A) or aviator's breathing-oxygen specifications (Type I, Quality Verification Level E) of CGA G–4.3–2000 (“Commodity Specification for Oxygen”). In addition, the commercial supplier must:
(i) Determine the O_2 fraction in the breathing-gas mixture using an analytic method that is accurate to within 1% of the O_2 fraction by volume;
(ii) Make this determination when the mixture is in the charged tank and after disconnecting the charged tank from the charging apparatus;

(iii) Include documentation of the O_2-analysis procedures and the O_2 fraction when delivering the charged tanks to the employer.
(d) Before producing nitrox breathing-gas mixtures using a compressor in which the gas pressure in any system component exceeds 125 pounds per square inch (psi), the:
(i) Compressor manufacturer must provide the employer with documentation that the compressor is suitable for mixing high-pressure air with the highest O_2 fraction used in the nitrox breathing-gas mixture when operated according to the manufacturer's operating and maintenance specifications;
(ii) Employer must comply with paragraph 6(e) of this appendix, unless the compressor is rated for O_2 service and is oil-less or oil-free; and
(iii) Employer must ensure that the compressor meets the requirements specified in paragraphs (i)(1) and (i)(2) of §1910.430 whenever the highest O_2 fraction used in the mixing process exceeds 40%.
(e) Before producing nitrox breathing-gas mixtures using an oil-lubricated compressor to mix high-pressure air with O_2, and regardless of the gas pressure in any system component, the:
(i) Employer must use only uncontaminated air (i.e*.,* air containing no hydrocarbon particulates) for the nitrox breathing-gas mixture;
(ii) Compressor manufacturer must provide the employer with documentation that the compressor is suitable for mixing the high-pressure air with the highest O_2 fraction used in the nitrox breathing-gas mixture when operated according to the manufacturer's operating and maintenance specifications;
(iii) Employer must filter the high-pressure air to produce O_2-compatible air;
(iv) The filter-system manufacturer must provide the employer with documentation that the filter system used for this purpose is suitable for producing O_2-compatible air when operated according to the manufacturer's operating and maintenance specifications; and
(v) Employer must continuously monitor the air downstream from the filter for hydrocarbon contamination.
(f) The employer must ensure that diving equipment using nitrox breathing-gas mixtures or pure O_2 under high pressure (*i.e.,* exceeding 125 psi) conforms to the O_2-service requirements specified in paragraphs (i)(1) and (i)(2) of §1910.430.
7. Emergency Egress
(a) Regardless of the type of diving equipment used by a diver (i.e*.,* open-circuit SCUBA or rebreathers), the employer must ensure that the equipment contains (or incorporates) an open-circuit emergency-egress system (a “bail-out” system) in which the second stage of the regulator connects to a separate supply of emergency breathing gas, and the emergency breathing gas consists of air or the same nitrox breathing-gas mixture used during the dive.
(b) As an alternative to the “bail-out” system specified in paragraph 7(a) of this appendix, the employer may use:
(i) For open-circuit SCUBA, an emergency-egress system as specified in §1910.424(c)(4); or
(ii) For a semi-closed-circuit and closed-circuit rebreather, a system configured so that the second stage of the regulator connects to a reserve supply of emergency breathing gas.
(c) The employer must obtain from the rebreather manufacturer sufficient information to ensure that the bail-out system performs reliably and has sufficient capacity to enable the diver to terminate the dive and return safely to the surface.
8. Treating Diving-Related Medical Emergencies
(a) Before each day's diving operations, the employer must:
(i) Verify that a hospital, qualified health-care professionals, and the nearest Coast Guard Coordination Center (or an equivalent rescue service operated by a state, county, or municipal agency) are available to treat diving-related medical emergencies;
(ii) Ensure that each dive site has a means to alert these treatment resources in a timely manner when a diving-related medical emergency occurs; and
(iii) Ensure that transportation to a suitable decompression chamber is readily available when no decompression chamber is at the dive site, and that this transportation can deliver the injured diver to the decompression chamber within four (4) hours travel time from the dive site.
(b) The employer must ensure that portable O_2 equipment is available at the dive site to treat injured divers. In doing so, the employer must ensure that:
(i) The equipment delivers medical-grade O_2 that meets the requirements for medical USP oxygen (Type I, Quality Verification Level A) of CGA G–4.3–2000 (“Commodity Specification for Oxygen”);
(ii) The equipment delivers this O_2 to a transparent mask that covers the injured diver's nose and mouth; and
(iii) Sufficient O_2 is available for administration to the injured diver from the time the employer recognizes the symptoms of a diving-related medical emergency until the injured diver reaches a decompression chamber for treatment.
(c) Before each day's diving operations, the employer must:

(i) Ensure that at least two attendants, either employees or non-employees, qualified in first-aid and administering O_2 treatment, are available at the dive site to treat diving-related medical emergencies; and
(ii) Verify their qualifications for this task.
9. Diving Logs and No-Decompression Tables
(a) Before starting each day's diving operations, the employer must:
(i) Designate an employee or a non-employee to make entries in a diving log; and
(ii) Verify that this designee understands the diving and medical terminology, and proper procedures, for making correct entries in the diving log.
(b) The employer must:
(i) Ensure that the diving log conforms to the requirements specified by paragraph (d) ("Record of dive") of §1910.423; and
(ii) Maintain a record of the dive according to §1910.440 ("Recordkeeping requirements").
(c) The employer must ensure that a hard-copy of the no-decompression tables used for the dives (as specified in paragraph 6(a) of this appendix) is readily available at the dive site, whether or not the divers use dive-decompression computers.
10. Diver Training
The employer must ensure that each diver receives training that enables the diver to perform work safely and effectively while using open-circuit SCUBAs or rebreathers supplied with nitrox breathing-gas mixtures. Accordingly, each diver must be able to demonstrate the ability to perform critical tasks safely and effectively, including, but not limited to: recognizing the effects of breathing excessive CO_2 and O_2; taking appropriate action after detecting excessive levels of CO_2 and O_2; and properly evaluating, operating, and maintaining their diving equipment under the diving conditions they encounter.
11. Testing Protocol for Determining the CO_2 Limits of Rebreather Canisters
(a) The employer must ensure that the rebreather manufacturer has used the following procedures for determining that the CO_2-sorbent material meets the specifications of the sorbent material's manufacturer:
(i) The North Atlantic Treating Organization CO_2 absorbent-activity test;
(ii) The RoTap shaker and nested-sieves test;
(iii) The Navy Experimental Diving Unit ("NEDU")-derived Schlegel test; and
(iv) The NEDU MeshFit software.
(b) The employer must ensure that the rebreather manufacturer has applied the following canister-testing materials, methods, procedures, and statistical analyses:
(i) Use of a nitrox breathing-gas mixture that has an O_2 fraction maintained at 0.28 (equivalent to 1.4 ATA of O_2 at 130 fsw, the maximum O_2 concentration permitted at this depth);
(ii) While operating the rebreather at a maximum depth of 130 fsw, use of a breathing machine to continuously ventilate the rebreather with breathing gas that is at 100% humidity and warmed to a temperature of 98.6 degrees F (37 degrees C) in the heating-humidification chamber;
(iii) Measurement of the O_2 concentration of the inhalation breathing gas delivered to the mouthpiece;
(iv) Testing of the canisters using the three ventilation rates listed in Table I below (with the required breathing-machine tidal volumes and frequencies, and CO_2-injection rates, provided for each ventilation rate):

Table I—Canister Testing Parameters

Ventilation rates (Lpm, ATPS[1])	**Breathing machine tidal volumes (L)**	**Breathing machine frequencies (breaths per min.)**	**CO_2 injection rates (Lpm, STPD[2])**
22.5	1.5	15	0.90
40.0	2.0	20	1.35
62.5	2.5	25	2.25

[1]ATPS means ambient temperature and pressure, saturated with water.
[2]STPD means standard temperature and pressure, dry; the standard temperature is 32 degrees F (0 degrees C).
(v) When using a work rate (*i.e.,* breathing-machine tidal volume and frequency) other than the work rates listed in the table above, addition of the appropriate combinations of ventilation rates and CO_2-injection rates;
(vi) Performance of the CO_2 injection at a constant (steady) and continuous rate during each testing trial;
(vii) Determination of canister duration using a minimum of four (4) water temperatures, including 40, 50, 70,

and 90 degrees F (4.4, 10.0, 21.1, and 32.2 degrees C, respectively);
(viii) Monitoring of the breathing-gas temperature at the rebreather mouthpiece (at the “chrome T” connector), and ensuring that this temperature conforms to the temperature of a diver's exhaled breath at the water temperature and ventilation rate used during the testing trial;[1]
[1] NEDU can provide the manufacturer with information on the temperature of a diver's exhaled breath at various water temperatures and ventilation rates, as well as techniques and procedures used to maintain these temperatures during the testing trials.
(ix) Implementation of at least eight (8) testing trials for each combination of temperature and ventilation-CO_2-injection rates (for example, eight testing trials at 40 degrees F using a ventilation rate of 22.5 Lpm at a CO_2-injection rate of 0.90 Lpm);
(x) Allowing the water temperature to vary no more than ±
2.0 degrees F (± 1.0 degree C) *between* each of the eight testing trials, and no more than ± 1.0 degree F (± 0.5 degree C) *within* each testing trial;
(xi) Use of the average temperature for each set of eight testing trials in the statistical analysis of the testing-trial results, with the testing-trial results being the time taken for the inhaled breathing gas to reach 0.005 ATA of CO_2(*i.e.,* the canister-duration results);
(xii) Analysis of the canister-duration results using the repeated-measures statistics described in NEDU Report 2–99;
(xiii) Specification of the replacement schedule for the CO_2-sorbent materials in terms of the lower prediction line (or limit) of the 95% confidence interval; and
(xiv) Derivation of replacement schedules only by interpolating among, but not by extrapolating beyond, the depth, water temperatures, and exercise levels used during canister testing.
[69 FR 7363, Feb. 17, 2004]

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Appendix L: EM 385-1-1 CH. 30

SECTION 30

Diving Operations

30.A General. All USACE diving operations, both government and contractor shall be performed in accordance with this manual. Failure to meet these requirements will be cause for rejection or cessation of operations.

30.A.01 *Unless otherwise delegated in this section*, requests for waivers or variance to the requirements of this section must be made in accordance with Appendix D of this manual through the local Designated Dive Coordinator (DDC) or the Alternate Dive Coordinator (ADC) acting on their behalf.

30.A.02 *Diving shall not be used* as a work method if the work objective can be more safely and efficiently accomplished by another means, including but not limited to, using Remotely Operated Vehicles (ROV's), and/or camera systems, or by dewatering the work area so work may be accomplished in the dry.

30.A.03 *Surface-Supplied Air (SSA)* shall be used whenever possible in accordance with the practical constraints of the diving operations.

30.A.04 Live boating will not be used without prior specific acceptance by the DDC.

30.A.05 *Training documentation shall be in compliance* with the OSHA Diving Standards 29 CFR 1910.410 and shall show that dive team members, including dive tenders, have successfully completed training to the appropriate level (e.g., SSA diver's certificate, surface supplied mixed-gas diver certificate). Copies of all dive-related training certificates are required. Such training shall be provided by:

a. A commercial diving school, military school, Federal school (e.g., USACE), or an Association of Commercial Diving Educators (ACDE) accredited school;

b. An in-house training program that meets the requirements contained in ANSI/ACDE01, or in the Association of Diving Contractors International (ADCI) Consensus Standards;

c. Training for Scientific Divers using compressed air (SCUBA or SSA), shall be in compliance with 29 CFR 1910.410 and shall meet the above requirements or the training guidelines in the Standards for Scientific Diving published by the American Academy of Underwater Scientists (AAUS).

30.A.06 Proof of certification (a diploma and/or official transcript) as a commercial working diver from an accredited commercial dive school and other dive-related training certificates (e.g. chamber operator, saturation diver, etc.) are required as proof of a dive team member's certification and/or experience. An ADCI card or similar certification from an internationally recognized commercial diving organization may be substituted as proof of training for divers demonstrating more than five (5) years of diving experience within the six (6) years preceding beginning of dive operations.

30.A.07 Contractors shall provide dive-log evidence that each dive team member has training and experience consistent with the performance requirements of the scope of work.

a. As a minimum, each diver, back-up diver, and dive team supervisor shall have at least 1 year of commercial experience in the applicable position.

b. Divers shall have completed at least 4 working dives with similar decompression techniques as in the dive plan, using the particular diving techniques and equipment. Divers shall demonstrate that at least 1 of the 4 qualification dives was performed in the last 9 months prior to the start of dive operations.

c. Dive tenders must have previous experience and training as a dive tender.

30.A.08 Each dive team member shall have current certification in first aid and CPR from the American Red Cross (ARC), the American Heart Association (AHA), or from an organization whose training adheres to the standards of the International Liaison Committee on Resuscitation, or from a Licensed Physician (LP).

a. Additionally, each dive team member shall have current certification in the use of emergency oxygen systems, and, if provided on the dive site, the use of Automated External Defibrillators (AEDs).

b. All classes shall contain a hands-on component and cannot be taken online. Evidence of this will be a photocopy of the certificates. The certificate(s) shall state the date of issue and length of validity.

Note: Training in the use of emergency oxygen systems shall be specific to underwater diving and shall meet the requirements of a nationally recognized training organization such as Divers Alert Network (DAN), Professional Association of Diving Instructors (PADI), National Association of Underwater Instructor s (NAUI), the YMCA or other recognized sources.

30.A.09 Divers shall receive an annual diving physical according to ADCI or similar standards preferably by a hyperbaric physician (MD or DO) or other licensed physician knowledgeable in the physiology of diving.

a. A “Fit to Dive” statement that each diver has been medically examined within the previous 12 months and has been determined fit and approved to dive shall be signed and signature stamped by the examining physician.

b. The DDC will maintain a file of physician “Fit to Dive” statement for all USACE qualified divers.

c. Contractors shall submit physician’s “Fit to Dive” statement to the DDC in accordance with Section 30.A.13.

d. After any serious diving-related injury or illness such as an over-pressurization injury and/or decompression illness, divers shall be re-examined by a hyperbaric physician and be re-certified as “Fit to Dive”.

30.A.10 Divers will wait at least 12 hours before flying after any dive. This interval should be extended to 24 hours following multiple days of repetitive dives.

30.A.11 When diving at altitudes of 1000 ft. (304.8 m) or more of elevation above sea level, dive supervisors shall use appropriate high-altitude decompression tables that compensate for the increased elevation.

30.A.12 Contract diving operations will be monitored and/or inspected by personnel qualified as USACE Dive Inspectors. Individual USACE Dive teams shall be inspected during operations at least once annually by the DDC, ADC and/or Dive Safety Representative (DSR).

a. Qualified Dive Inspectors shall hold current USACE training certification as Dive Inspector, Diver/ Dive Supervisor, Dive Safety Administrator, or Dive Coordinator. All USACE personnel used as dive inspectors must be approved by the DDC prior to performing inspector duties.

Note: Use of trained monitors/inspectors with other credentials will be considered on a case-by-case basis and may be approved in writing by the DDC and HQUSACE Program Manager (PM) for Diving Safety.

b. Inspectors shall conduct on-site monitoring/inspections of contractor dive sites during pre-dive conference, equipment inspection, and initial dives. Monitoring should be continuous for the duration of the contract dive activity but may be intermittent, as determined by the DDC based on an evaluation of the job complexity and degree of hazards.

30.A.13 The following documents are required for all Contractor diving operations. All documents will be reviewed and found acceptable by two of the following: DDC/ADC/DSR, prior to start of diving operations. Contractors shall submit the documents to the DDC through the Contracting Officer (KO). Additional documentation may be required depending on the scope of the diving operation:

a. Safe Practices Manual; > See Section 30.A.15.
b. Dive Operations Plan(s); > See Section 30.A.16.
c. AHA to cover all aspects of the job; > See Section 30.A.17.
d. Emergency Management Plan; > See Section 30.A.18.
e. Dive Personnel Qualifications. > See Sections 30.A.05 – 30.A.09.

Note: The above review requirement is that two USACE Qualified Personnel independently evaluate the documents prior to acceptance. The ADC may substitute for either the DDC or DSR in the review and/or acceptance process if these personnel are not available at the time of review.

30.A.14 A Dive Operations Plan, AHA, emergency management plan, and personnel list with qualifications will be developed for each separate diving operation.

a. These documents will be submitted to the DDC through the KO for review, and found acceptable, prior to commencement of diving operations and will be at the diving location at all times. Each of these documents will become a part of the project file.

b. Potential high-hazard conditions, such as penetration diving, contaminated environment diving, dives outside the no decompression limits, and in areas where differential pressure entrapment hazards exist, will be specifically addressed in the Dive Operations Plan and AHA when they are anticipated as part of the diving operation.

c. Diving in contaminated water is prohibited for all USACE projects unless supporting documentation is provided that demonstrates that divers and topside personnel are not exposed to, or will be protected from, known or potential contamination hazards that would pose a chronic or acute health risk.

(1) All divers and topside personnel shall be trained, equipped and resourced to dive in contaminated water.

(2) The dive plan shall be accepted by the GDA within 10 business days prior to dive operations and shall specifically address the areas below in accordance with the U.S. Navy Guidance for Diving In Contaminated Waters, SS521-AJ-PRO-010 located at the U.S. Navy SEA 00C3 website:

(i) Types of contaminants and Category (CAT 1, 2, 3, 4). Additional hazard scenarios and control measures shall be considered for surface, mud-line/sediment, rainfall, points of discharge, and vertical and bottom water contamination (i.e., a diver walking/crawling/working including swim fin action that stirs up bottom sediments);

(ii) Levels of protection and protective equipment;

(iii) Contaminated water diver and topside personnel training and qualifications;

(iv) Sources of information used to determine water quality;

(v) Dive Station Decontamination Procedures for Divers and Topside Personnel;

(vi) Medical evaluation support and post dive monitoring;

(vii) Hazardous waste minimization and disposal.

30.A.15 Safe Practices Manual. Contractors and USACE Districts/Labs with in-house dive teams shall develop and maintain a safe practices manual that encompasses their entire diving program. The safe practices manual shall be available at all times to the Government representative and all dive team members at each diving location. The safe practices manual shall include, as a minimum, the following:

a. Dive safety procedures and checklists;

b. Assignments and responsibilities of dive team members;

c. Equipment certifications, procedures, and inspection checklists;

d. Emergency procedures for fire, equipment failure, adverse weather conditions, and medical illness or injury and specific procedures for:

(1) Entrapped or fouled diver including fouled umbilical (suction and entanglement/debris);

(2) Actions upon loss of vital support equipment;

(3) Actions upon loss of gas supply;

(4) Action upon loss of communication;

(5) Lost diver plan (SCUBA Operations only);

(6) Injured diver plan;

(7) Actions upon discovery of fire;

(8) Diver blow up/over rapid ascent to surface;

(9) Diver loss of consciousness; and

(10) Injury/illness of member of surface crew with diver in the water.

e. Procedures for internal safety inspections (frequency, checklists, etc.);

f. A complete copy of OSHA, 29 CFR 1910, Subpart T, and a statement of the employer's policy for ensuring compliance with the standard;

g. The appropriate U.S. Navy Table(s), including as a minimum:

(1) U.S. Navy Table of No-Decompression Limits and Repetitive Group Designation for No-Decompression Air Dives;

(2) U.S. Navy Residual Nitrogen Timetables for Repetitive Air Dives;

(3) U.S. Navy Standard Air Decompression Table.

h. A sample of the diving log sheets to be used;

i. A sample of the repetitive dive worksheets or equivalent (dive profile method) to be used;

j. An outline of the fitness for duty (including medical) requirements for dive team members, and

k. An outline of administrative and record-keeping procedures.

30.A.16 Dive Operations Plan. This plan is a general overview of all tasks to be performed, dive modes and equipment, site access, etc. Complex projects involving more than one work task, location, and/or dive team require task-specific dive plans as part of the overall Dive Operations Plan. As a minimum, the Dive Operations Plan will contain the following:

a. Date of dive plan submission;

b. Name and contact information for diving supervisor preparing the dive plan;

c. Names and duties of on-site dive team members, including diving supervisor;

d. List of diving equipment to be used;

e. Type of diving platform to be used;

f. Detailed description of the mission; Identify how/if work will be divided into separate tasks or phases of work;

g. Date(s), time(s), duration, and location of operation;

h. Diving mode used (SCUBA, SSA, and snorkeling) including a description of the backup air supply, as required;

i. Nature of work to be performed by the divers, including tools used and materials to be handled or installed;

j. Anticipated surface and underwater conditions, to include visibility, temperature, currents, etc. Thermal protection will be considered as appropriate;

k. Maximum single dive bottom time for the planned depth of dive for each diver. Altitude adjustments to dive tables will be calculated for dives made at altitudes of 1000 ft (304.8 m) or more above sea level;

l. Identification of topside assistance/support to the dive team (i.e., crane operator, lock operator, etc.);
m. Means of direct communication between the dive site and the DDC, project office, the lockmaster or USACE project manager, and the contracting officer (if applicable);

n. Plans submitted for Contractor operations shall also include the name of Contractor (and diving subcontractor if applicable), Contract number, and names and contact information for key personnel.

Note: The dive plan will include the following statement: "If for any reason the dive plan is altered in mission, depth, personnel, or equipment, the DDC will be contacted in order to review and accept the alteration prior to actual operation."

30.A.17 Activity Hazard Analysis (AHA). An AHA represents the dive team's best effort to anticipate and mitigate or prevent the adverse effects of equipment failure, extreme weather and environmental conditions, or other hazardous/unexpected situations.

a. AHA's shall address risk to personnel, property and to impacts to the overall USACE mission. When required, a new AHA shall be conducted to reflect changes in site conditions, operational changes, etc.

b. Each AHA will be job specific and address each phase of work, to include the hazards associated with flying after diving.

c. For USACE dive teams, a Risk Assessment Code (RAC) shall be applied to all underwater diving activities, with residual risk being approved by the appropriate level of command.

b. Hazardous Energy Control (HEC) procedures in accordance with Section 12 of this manual and procedures for dealing with differential pressures will be included if appropriate.

(1) If HEC procedures are required for the diving operation, the diving supervisor will visually check all lockout/tagout and other control procedures/devices to assure they are in place and redundant where possible prior to the commencement of the diving operation.

(2) A copy of any clearances/permits to be issued to deal with identified hazards will be attached to the AHA.

e. Some dives may be sufficiently complex to warrant several separate analyses.

f. The AHA will be covered in detail at the pre-dive conference.

30.A.18 Emergency management plan. An emergency management plan will be prepared for each dive operation. The minimum content of the plan will be as follows:

a. Location and phone number of nearest operational recompression chamber if not located at the dive site and the Divers Alert Network (DAN) phone number (919-684-9111);

b. Location, directions to and phone number(s) of nearest hospital(s) or available physicians capable of treating dive injuries;

c. Location and phone number of nearest USCG Rescue Coordination Center, where appropriate;

d. Description of an emergency victim transport plan including phone numbers of appropriate emergency transport services;

e. Procedures and phone numbers or other means of communications to activate emergency services at the facility where the work is being performed;

f. Diver rescue procedures conducted by the dive team, including responsibilities of team members, best location(s) where injured divers may be removed from the water, and best location(s) for performing first aid/stabilization prior to emergency medical assistance arrival.

30.A.19 Prior to the initial work on each dive operation, a Pre-Dive Conference shall be held with key personnel designated by the DDC to discuss the Dive Operations plan, AHA, and Emergency Management Plan and any modifications needed. For contractor operations, the pre-dive conference will also be attended by the USACE dive inspector or DDC and a representative of the Contractor with sufficient authority to implement any changes required by the USACE diving inspector or coordinator.

30.A.20 Prior to each dive, the entire dive team will be briefed in detail on the following (as a minimum):

a. Description of mission and location, including drawings and/or photographs pertinent to the mission and equipment and materials that are to be installed as part of the mission;

b. Description of diving apparatus/equipment and craft to be used;

c. Maximum working depth with estimated bottom times and water temperatures;

d. Names and duties of personnel on the team (when possible, incorporate at least one person on the dive that has previously performed the same or similar mission);

e. Discussion of AHA; and

f. Emergency procedures.

30.A.21 Upon completion of each diving operation or at the conclusion of each day, a dive team debriefing shall be conducted by the dive supervisor. At the debriefing divers are advised of the location of the nearest recompression chamber (if not located on site), the phone number for DAN or local dive medical facility, and cautioned on the limitations of their post dive activities including repetitive dives, traveling to higher altitude, and flying.

30.A.22 If for any reason the dive mission is altered:

a. Minor to moderate revisions to the accepted dive plan will be reviewed and accepted by the DDC or ADC prior to continuing the operation. These revisions may include differences in time, date, dive team members, work methods/tools used, and other changes that do not affect overall risk. This review may be conducted electronically or verbally and confirmed in writing after completion of the dive operation.

b. Major changes or those which modify high-risk activities, such as modifying pressure differential and hazardous energy controls, adding penetration diving, changing dive equipment modes (i.e. from SCUBA to SSA), discovery of unexpected contaminated diving conditions, etc. require a two-person review as outlined in Section 30.A.13.

c. For contract operations, the project superintendent or the dive supervisor shall submit/request the revised plan through the GDA for DDC acceptance.

30.A.23 All diving activities shall be conducted with full knowledge and close coordination with the GDA and on-site authorities such as the dive inspector, lockmaster/project manager, etc.

30.A.24 For each diver and dive, the following dive log information, as a minimum, shall be recorded and maintained at the dive location:

a. Full name;

b. Date, time and location of dive;

c. Maximum depth and bottom time;

d. Surface interval between dives;

e. Breathing medium and type of equipment used;

f. Group classification at the beginning and end of each interval and repetitive dive worksheet;

g. Underwater and surface conditions;

h. Depth(s) and duration(s) of any decompression stops;

i. Date and time of last previous dive if it occurred in the last 24 hours;

j. Name of Dive Supervisor(s) during dive;

k. General description of work performed; and

l. For dives outside the no-decompression limits, deeper than 100 ft salt water (fsw) (30.5m), or using mixed-gas, include depth-time and breathing-gas profiles and decompression tables (including any modifications).

30.A.25 For each dive in which decompression sickness and/or pulmonary barotraumas is suspected or symptoms are evident, the following information shall be recorded and maintained:

a. Descriptions of signs and symptoms (including depth and time of onset);

b. Description and results of treatment; and

c. Name, address, and phone number of attending physician.

30.A.26 Prior to the dive, the Dive Supervisor shall assure, as a minimum, the following pre-dive checks are performed:

a. Breathing air tanks contain sufficient air supply to perform the required work (i.e., standby air tanks are on site and full to the necessary capacity);

b. All diving equipment shall be checked for proper function prior to diver entry;

c. All necessary safety equipment specified herein is on site and functioning properly;

d. Lockout/tagout procedures are followed;

e. When applicable, crane signals are reviewed and radio communication with the crane operator is functioning properly;

f. When applicable, welding or cutting procedures are clearly reviewed, the proper welder polarity is set, and precautions have been taken to ensure that electrocution will not occur;

g. When applicable, blasting procedures are clearly reviewed and precautions have been taken to ensure unplanned/unscheduled blasts will not occur;

h. A pre-dive briefing shall be given that includes, but is not limited to, the accident management plan, AHA, equipment checklist, diving logs, diving conditions, and diving procedures;

i. When applicable, manbaskets used for diver access shall be inspected and load tested prior to use, and a Critical Lift Plan shall be submitted per Section 16.H and Section 30.B.06).

30.A.27 Copies of the dive logs shall be submitted to the DDC after completion of the dive operation. For USACE dive teams, these records shall be maintained on file for two years.

30.B Diving Operations.

30.B.01 Staging areas, where the fully suited and equipped diver enters the water, shall be selected and configured based on a hazard analysis that includes an examination of:

a. Ease of diver access to the water;

b. Hazards to diver (currents, equipment, etc.) in route from surface to work area;

c. Ability of standby diver to access the water immediately and to reach the diver quickly;

d. If used as the topside dive team station, the ability to protect topside members and the standby diver from weather, operational, and other hazards;

e. Whether topside equipment can be stowed safely and function properly;

f. If diver entry to water is remote from the staging area, the standby diver shall be placed at the water entry or immediately accessible to it.

30.B.02 All Dive teams shall be manned in accordance with the criteria established in Appendix G.

30.B.03A standby diver will be provided whenever a diver(s) is in the water to serve as immediate emergency assistance to the primary diver(s).

a. Untethered SCUBA divers, working in “buddy” pairs, shall have one tethered standby diver at the surface for each pair.

b. A standby diver will deploy only after the dive supervisor assesses the situation and instructs him/her to do so.

c. The standby diver shall be fully equipped to dive and immediately available the entire time the diver is in the water.

    (1) The standby shall don all specific gear (suits, harnesses, and equipment) they will wear/use and test all for proper operation before the primary diver leaves the surface.

    (2) With the exception of Appendix G, Table G-3, the stand-by diver shall not assume other work responsibilities, other than communications, as required, with the diver.

    (3) All gear shall be maintained operational and ready for immediate use for the duration of the dive. If any of the tested gear is exchanged or replaced during the dive, it shall be donned and tested by the standby.

d. The standby diver shall be dressed appropriately for the water and air temperature and remain fully suited up with helmet/mask ready for immediate donning from the time the primary diver leaves the surface until reaching the work area/working depth. The standby may remove the portions of his or her gear needed to prevent heat/cold stress and prevent fatigue. If the AHA identifies a need for the standby diver to remain fully dressed to deploy, it will address measures that will be taken to control these hazards (i.e., standby in water at surface). Any gear that has been removed must be maintained ready for immediate donning and use, accessible to the standby at the entry to the water.

e. If configuration of the surface staging area prevents safe, immediate entry of the standby into the water, the standby diver will be placed in the water fully dressed prior to the primary diver leaving the surface, and remain at the surface ready for deployment if needed.

30.B.04 Dive operations that require surface decompression as an integral part of the dive operation shall have a trained competent person (CP)/operator, whose sole purpose is to attend to the chamber operation.

a. In dive operations where the chamber is required for emergency, first aid, or used for other unexpected recompression events, a team member with other team duties (tender, console operations, etc.) not diving during the current dive may serve as the chamber operator so long as he is specifically trained and competent in hyperbaric chamber operations. If used for the latter purpose, all diving shall be suspended during the chamber operations.

b. Whenever a chamber is on site, the chamber CP/operator shall be capable of communicating with a diving physician.

c. Divers completing a recompression dive will remain within 60 minutes drive time from a fully operable and staffed recompression chamber for a minimum of 2 hours after completing the recompression dive.

30.B.05 Dive operations will be conducted in full coordination with external operations and processes that may impact the safety of the dive.

a. When the operation of machinery or release of hazardous energy will affect the diver or dive team safety, the dive supervisor will develop a HECP. > See Section 12. When diving at a facility with an existing HECP, the dive supervisor will review the facility's plan and establish positive control procedures with the facility leader.

b. When water traffic, land-based traffic, industrial operations, heavy equipment operation, or other operations exist that present a hazard to the diver or dive team, the dive supervisor shall coordinate with the controlling authorities to minimize the hazards. This shall include coordination with the USCG, as required, for establishing a safety zone.

30.B.06 Crane operations conducted to support diving operations shall follow the requirements of Section 16 of this manual.

a. All working dives requiring communications between the divers and topside to direct crane load movements, etc., shall be performed in SSA mode.

b. The crane operator will take direction from the tender or supervisor directly in communication with the diver.

c. Crane operations where the load is placed or removed while a diver is underwater shall be considered Critical Lifts and the diver/load director will participate in the Critical Lift Plan development as outlined in Section 16.H.

d. If divers are required to perform rigging duties, they must be a qualified rigger and meet the personnel qualifications listed in Section 15.B.

30.B.07 When dives will take place in an area or facility where potential or actual pressure differentials exist (i.e., locks, dams, spillways, powerhouses, etc.), the dive supervisor will develop specific plans and procedures, in coordination with the facility operator, to prevent diver exposure to pressure differentials. The plans and procedures shall be site-specific and include the following:

a. Identification of all potential exposure points (gate sills, valve openings, holes, etc.);

b. Means for identifying whether control structures/mechanisms are fully in place (measurements of stop gates and openings, valve indicators, etc.);

c. Methods for checking pressure differential openings (observing current/water flow, remote testing of opening area with objects (rope, sandbags, cinders, etc.);

d. Route diver will take from staging area to work area with specific designs to prevent diver and umbilical from uncontrolled pressure differential openings;

e. Procedures for immediate emergency pressure equalization or reduction, if possible, and

f. Procedures for emergency diver extraction or rescue due to pressure differential exposure, including standby diver deployment precautions.

30.B.08 Underwater Welding and Burning Operations.

a. Underwater welding and burning shall be limited to SSA mode only.

b. Equipment configuration and procedures shall be in accordance with the U.S. Navy Underwater Cutting & Welding Manual, S0300-BB-MAN-010.

c. Divers performing underwater welding and burning operations shall be equipped with the following as a minimum:

(1) A rubber or neoprene dive suit in good condition that provides electrical insulation to the diver;

(2) Insulating gloves with a cuff that, as a minimum, reaches and fully covers the wrist;

(3) A welding/burning eye shield attached to the dive helmet with appropriate shade for the conditions at the working area.

30.C SCUBA Operations.

30.C.01 SCUBA diving operations shall not be conducted:

a. At depths greater than 100 ft (30.5 m);

b. On dives outside the no-decompression limits unless a dual lock, multi-place, recompression chamber (capable of recompressing diver at the surface to a depth equivalent to 165 ft (50.3 m) of sea water) is available at the dive location and is immediately available for use, a trained competent operator is on site, and the chamber is of sufficient size to accommodate the diver as well as an inside tender;

c. Against currents exceeding one knot;

d. In enclosed or physically confining spaces;

e. Using closed circuit or semi-closed circuit SCUBA;

b. In visibility less than 3 ft (0.9 m) unless line tended with diver/surface two-way voice communications;

c. In areas where pressure differentials exist and it cannot be positively verified that all potential leaks have been eliminated;

d. When the diver does not have direct access to the surface.

30. C.02 Specific operational requirements for SCUBA operations are as follows:

a. The minimum sized SCUBA tank allowed as primary air is a standard 80 ft3 aluminum tank pressurized to at least 2,700 PSI at the beginning of dive operations.

(1) Divers shall terminate their dive so that they reach the surface with a minimum tank pressure of 500 PSI.

(2) Each diver shall be equipped with a minimum 30 ft3 bailout bottle for emergency use pressurized to at least 90 percent of its working PSI rating and equipped with a separate 1st and 2nd stage regulator. An “octopus” is not considered to be an alternate air source.

b. Each diver shall be equipped with a buoyancy compensation device (BCD) having a manually activated inflation source, an oral inflation device, and an exhaust valve.

c. Each SCUBA diver shall be equipped with a submersible cylinder pressure gauge capable of being monitored by the diver during the dive.

d. Each SCUBA diver shall be equipped with a weight belt or assembly capable of quick release.

e. Each SCUBA diver shall be equipped with a depth gauge and knife.

f. SCUBA air cylinders shall comply with the following requirements:

(1) Air cylinders of seamless steel or aluminum that meet DOT 3AA and DOT 3AL specifications are approved for used on USACE projects;

(2) Each cylinder used on USACE projects must have identification symbols stamped into the shoulder of the tank; and

(3) SCUBA tanks used on USACE projects must be visually inspected internally at least annually and hydrostatically tested at least once every 5 years in accordance with DOT and the CGA regulations; hydrostatic test dates will be stamped into the shoulder of each tank.

g. A timekeeping device shall be used for recording diving times for all SCUBA diving operations. When two-way voice communications are not used, each dive supervisor and diver shall have a timekeeping device. When two-way voice communications are used, the dive supervisor, at a minimum shall have a timekeeping device.

h. Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious or inert.

30.D Surface Supplied Air (SSA) Operations.

30.D.01 SSA operations shall not be conducted at depths greater than 190 ft (57.9 m) except that dives with bottom times of 30 minutes or less may be conducted to depth of 220 ft (67 m). Exceptional exposure dives, as defined by the US Navy Diving Manual, shall not be conducted except in emergency lifesaving situations. USACE in-house SSA operations shall not exceed a depth of 110 ft (33.5 m) unless a waiver is requested by the DDC and approved by the HQUSACE Dive Safety Program Manager.

30.D.02 SSA equipment components shall be a type specifically designed to be used in diving support systems.

30.D.03 A recompression chamber shall be available for all SSA operations when diving outside the decompression limits, utilizing mixed gas, and/or when diving at or deeper than 100 ft (30.5 m) is planned.

a. Under these conditions, a dual lock, multi-place, recompression chamber (capable of recompressing a diver at the surface to a depth equivalent to 165 ft (50.3 m) of sea water) must be available at the dive location and immediately available for use.

b. The chamber must be of sufficient size to accommodate the diver as well as an inside tender, and a trained chamber operator must be immediately available.

c. Sufficient oxygen shall be available to complete chamber operations.

30.D.04 A bell shall be used for dives with an in-water decompression time greater than 120 minutes, unless heavy gear is worn or diving is conducted in physically confining spaces.

30.D.05 Minimum specific operational requirements for SSA diving operations are as follows:

a. Each diver shall be continuously tendered while in the water, with one diver per tender, regardless of depth. The tender shall not perform any other duties outside of tending the diver except as allowed by Appendix G;

b. An underwater tender/diver shall be stationed at the immediate underwater point of entry when any overhead obstruction limiting direct access to the surface is present and/or penetration diving is conducted or in enclosed or physically confining spaces;

c. Each diving operation shall have a primary breathing air supply sufficient to support divers for the duration of the planned dive, including decompression;

d. Each diver must have a reserve breathing supply available that can be turned on immediately by the diver in the event of loss of air. The reserve breathing air supply shall be of sufficient capacity to recover the diver and complete emergency recompression (if required) in the event of loss of primary air but no less than 30 ft3 (0.85 m3). Heavy-gear diving is exempted from these provisions because the gear carries its own reserve;

e. Each dive location shall have a reserve breathing air supply integral or in-line with the primary air source sufficient to safely terminate the dive and recover the diver(s) in the event of loss of the primary air supply;

f. For dives deeper than 100 ft (30.5 m) or outside the no decompression limits and using heavy gear, a spare air supply hose, to replace the diver's air hose should it become damaged, shall be available to the standby diver. An in-water support stage shall be provided to divers in water when using heavy gear, regardless of depth;

g. Electronic communication systems with an external speaker shall be incorporated so the entire dive team can monitor communications.

(1) Communications devices shall be tested prior to each dive, maintained in an operable condition, and protected from damage during use and storage IAW the manufacturer's recommendations.

(2) All dive operations will be terminated in a safe, orderly fashion using line-pull signals if voice communications are lost.

(3) Defective electronic communication equipment shall not prevent a standby diver from deploying in an emergency if the dive supervisor determines it is safe for the diver to deploy and line-pull signals are used.

30.E Mixed-Gas Diving Operations.

30.E.01 A dual lock, multi-place, recompression chamber with a trained, competent operator shall be available and ready for use at the dive location for any mixed-gas dive. Sufficient oxygen shall be available to complete chamber operations. At extreme depth, mixed gas diving can only be done if:

a. A bell is used at depths greater than 220 ft (67 m) or when the dive involves in-water decompression time of greater than 120 minutes (except when heavy gear is worn or when diving in physically confining spaces), or

b. A closed bell is used at depths greater than 300 ft (91.4 m), except when diving is conducted in physically confining spaces.

30.E.02 Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive, including decompression.

30. E.03 Each diving operation shall have a reserve breathing gas supply integral or in-line with the primary air source sufficient to safely recover the diver(s) in the event of failure of the primary breathing gas supply.

30. E.04 When heavy gear is worn:

a. An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the standby diver, and

b. An in-water stage shall be provided to divers in the water.

30.E.05 An in-water stage shall be provided for divers without access to a bell for dives deeper than 100 ft (30.4 m) or outside the no-decompression limits.

30.E.06 When a closed bell is used, one dive team member in the bell shall be available and tend the diver in the water.

30.E.07 Oxygen Enriched Air.

a. The use of “Oxygen Enriched Air” (OEA) such as Nitrox (EANx) breathing mixtures by USACE in-house dive teams requires the specific initial approval of the HQUSACE Dive Safety Program Manager prior to the first use of such equipment. Requests for approval will be accompanied by a written program that identifies training, certification, and procedures for OEA use. Use of OEA by Contractors requires approval by the local DDC.

b. Navy or NOAA Nitrox Dive Tables or other decompression tables designed specifically for the OEA mixture being used shall be followed without exception.

c. The use of OEA/Nitrox is considered mixed gas diving and requires a decompression chamber on site and ready for use.

30.E.08 Contractors must provide evidence of training and experience with OEA breathing mixtures prior to actual diving operations.

30.E.09 OEA breathing mixture shall be analyzed/tested by the diver to assure proper mix prior to each use. No more than 40% OEA is allowed for normal diving operations. Higher OEA concentrations are allowable for in-water decompression at shallow safety stops.

30.E.10 Use of Surface Decompression with Oxygen (SUR-D-O2) and/or 100% oxygen in-water decompression by trained and certified dive teams, shall only be authorized as a decompression methodology upon submittal of an oxygen-specific decompression plan and schedule, and only with the expressed written approval of the District Dive Coordinator or alternate.

30. F Equipment Requirements.

30.F.01 Equipment modifications, repairs, tests, calibrations, or maintenance shall be recorded by means of a tagging or logging system, and include the date and nature of work performed and the name of the individual performing the work.

30.F.02 Air compressor systems used on-site as a direct source to supply air to SSA divers (Direct Source Compressors) shall be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

30.F.03 Direct Source compressors shall be of sufficient capacity to overcome any line loss or other losses and deliver a minimum 4.5 ft3 (2.1 l/s), actual, or a delivery amount (cfm) as set by the helmet manufacturer, to each diver at the maximum diving depth.

30.F.04 All air compressor intakes shall be located away from/upwind of areas containing exhaust or other contaminants.

a. All shall be equipped with appropriate in-line air purifying absorbent beds and/or filters inserted into the supply line to assure breathing air quality.

b. Oil-lubricated compressors containing a petroleum or potential CO-producing lubricant for the air pressurization pistons will not be used.

c. All monitor/alarm systems shall be so designed with a visual and/or audio alarm and placed so that the dive supervisor will be made aware of the hazardous conditions.

d. Direct Source compressors shall be equipped specifically for their intended use and shall have a suitable approved means to regulate the pressure and a low air pressure alarm in the system. In addition, they will have a Carbon Monoxide (CO) monitor with alarm in the following situations:

(1) The compressor is powered by an internal combustion engine,

(2) Compressors used in close proximity to internal combustion engines that may/will be running during dive operations (boat motors, generators, cranes, etc.). Air intake pipes shall be placed away from/upwind of the exhaust source;

(3) Fueling a compressor during operation shall not be allowed.

30.F.05 Air compressor systems will be tested by means of sampling at the connection to the distribution system.

a. All air compressors with a working pressure greater than 500 psi will be tested every six months by an accredited testing laboratory.

b. Compressors with a working pressure less than 500 psi may be tested in-house with documentation every six months and must be tested by an accredited testing laboratory every two years. Lab accreditation shall be from NIST/NVLAP, American Association of Laboratory Accreditation (A2LA – for environmental or calibration) or similar recognized accreditation.

c. Purchased air must be certified by the supplier that it has been tested and meets the standards below.

d. A copy of the certificate of analysis showing the breathing air meets the minimum acceptable criteria shall be provided to the GDA.

e. Air purity standards are as follows:

(1) Air shall not contain a level of carbon monoxide greater than 10 ppm;
(2) Air shall not contain a level of carbon dioxide greater than 1,000 ppm;
(3) Air shall not contain a level of oil mist greater than 5 mg/m3;
(4) Air shall not contain a level of hydrocarbons other than methane greater than 25 ppm; and
(5) Air shall not contain a noxious or pronounced odor.

30.F.06 Breathing supply hoses.

a. Breathing air supply hoses shall be suitable for breathing gas service or shall be specifically manufactured for SSA use. Hoses shall have a maximum allowable working pressure equal to or greater than supply pressure plus 150 psi.

b. Breathing air supply hoses shall have connectors made of corrosion resistant materials and have a working pressure at least equal to the working pressure of the hose to which they are attached: connectors must not be able to become accidentally disengaged.

c. Umbilicals shall be marked, beginning at the divers end, in 10 ft (3 m) increments to 100 ft (30.5 m) and in 50 ft (15.2 m) increments thereafter. > See Table 30-1. USACE inhouse dive teams shall use the following umbilical marking system found in the ADCI Consensus Standard 006 in order to assure consistency and interoperability:

d. Umbilicals shall have a nominal breaking strength of 1000 lb (453.6 kg) and shall be made of kink resistant materials.

e. Hoses must be tested prior to being placed into initial service and after any repair, modification, or alteration, and at least every 12 months to 1.5 times the working pressure. Umbilical assemblies shall be tensile tested at the same time intervals by subjecting each hose-to-fitting connection to a 200 lb axial load.

f. When breathing gas hoses are not in use, their open ends must be closed by capping.

g. The umbilical assembly used for the standby diver must be of sufficient length to reach the primary diver at the furthest distance he can proceed from the dive station or beyond.

h. Umbilicals shall be carefully tended to maintain them and the diver clear of hazards such as propellers (including those of ROV's) or intakes present in the diving zone, so that the diver or umbilical cannot be drawn into them.

30.F.07 SSA and mixed-gas helmets and masks shall have a non-return valve at the attachment between the helmet or mask and hose which will close readily and also have an exhaust valve.

a. Helmets and masks shall have a minimum ventilation rate capacity of 4.5 ft3 (2.1 L/s) (actual) at the depth at which they are operated.

b. The use of Jack Brown masks is prohibited on SSA operations unless it incorporates electronic communication and a means of incorporating a diver carried bailout system.

TABLE 30-1 Umbilical Markings

Distance (from diver's end)	Marking
10 ft [3 m]	one white band
20 ft [6.1 m]	two white bands
30 ft [9.2 m]	three white bands
40 ft [12.2 m]	four white bands
50 ft [15.2 m]	one yellow band
60 ft [18.3 m]	1 yellow/1 white
70 ft [21.3 m]	1 yellow/2 white
80 ft [24.4 m]	1 yellow/3 white
90 ft [27.4 m]	1 yellow/4 white
100 ft [30.5 m]	1 red band
150 ft [45.7 m]	1 red/1 yellow
200 ft [61 m]	2 red bands
250 ft [76.2 m]	2 red/1 yellow
300 ft [91.5 m]	3 red bands

Note: For each 50 ft (15.2 m) thereafter the sequence continues by increasing the number of red bands at each even increment of 100 ft (30.5 m). In cases where the umbilical color matches an above band color, a reasonable substitute may be used (contrasting outline on same-color tape, contrasting diagonal pattern, replacement with color not used above).

30.F.08 SSA and mixed-gas helmets and masks must be capable of supporting a reserve breathing supply which can be immediately turned on by the diver in event of loss of air.

30.F.09 SSA and mixed-gas helmets and masks must be capable of supporting a two-way or four-way diver-surface communication system.

30.F.10 Weights and harnesses. Unless heavy gear is worn, each tethered diver shall wear a divers safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious or inert.

30.F.11 The following emergency and first aid equipment shall be located at all dive sites:

a. A first aid kit meeting the requirements of Section 3;

b. An oxygen resuscitation system shall contain a pocket mask with O2 inlet, nonrebreather mask, demand inhalator and/or demand resuscitator capable of delivering oxygen for a minimum of 30 minutes at 15 lpm or until emergency medical assistance can be administered; and

c. A stokes litter or backboard, equipped with at least four body straps and snap buckles, a head block and have flotation capability.

30.F.12 When diving from vessels, International alpha code and recreational dive flags with a minimum dimension of 23 in (58.4 cm) will be displayed a minimum of 3 ft (0.9 m) above the working surface at the dive location during diving operations. When diving from surfaces other than vessels in areas capable of supporting marine traffic, a rigid replica of the international code flag "A" at least 3 ft (1 m) in height shall be displayed at the dive location in a manner which allows all-round visibility, and shall be illuminated during night diving operations.

30.F.13 Hand-held power tools shall be tested and certified to be safe for underwater use. These tools shall be de-energized at the surface before being placed into or retrieved from the water and shall not be supplied with power until requested by the diver.

30.F.14 The use of one-atmosphere suits (e.g., Newt Suits) requires the specific approval of the MSC DDC and FOA DDC prior to the use of such equipment.

30.G Scientific Snorkeling.

30.G.01 Scientific snorkeling will be conducted only with prior acceptance of the DDC.

30.G.02 Scientific snorkeling will be allowed only for environmental assessments such as fish surveys, stream surveys, and the like. It will not be used for structural inspections or other work.

30.G.03 An on-site snorkeling team shall be made up of no less than two persons: snorkeler, and observer/assistant. Additional site personnel may be required by the DDC or Safety Office DSR based on site hazards and conditions. Snorkeling team plans and procedures shall be developed and enacted by a team supervisor who is qualified and experienced in scientific snorkeling.

30.G.04 Quality assurance for contractor snorkeling operations will be provided by USACE certified Diving Inspectors or qualified USACE scientific snorkelers.

30.G.05 Scientific snorkeling will only be done on the surface of the water. No diving of any kind is permitted.

a. Untethered scientific snorkeling will NOT be allowed in waters deeper than 5 ft (1.5 m), in bodies of water that a snorkeler cannot wade across, or anywhere a pressure differential may exist.

b. Scientific snorkeling in open waters greater than 5 feet deep may be allowed by the local DDC based on an acceptable AHA and compliance with all of the following:

(1) The snorkeler shall be tethered with a harness and a maximum of 40 ft (12.2 m) of floating line;

(2) The tether must be constantly tended from the shore or boat;

(3) The snorkeler must wear a device providing a minimum of 15.5 lbs (7 kg) of positive buoyancy (Type III PFD, fully inflated snorkeling vest, etc.), and

(4) There are no potential tether entanglement hazards in the snorkeling area (overhanging branches, surface stumps, rocks, etc.).

30.G.06 All snorkelers and observers/assistants will be certified as skin divers (snorkelers) or open water divers by a nationally-recognized organization (e.g., Professional Association of Diving Instructors (PADI), National Association of Underwater Instructors (NAUI), etc.) or the U.S. Forest Service Snorkel Safety Program.

30.G.07 An observer/assistant will accompany each untethered snorkeler either along the shore or in a boat and be within 50 ft (15.2 m) of the snorkeler at all times.

a. Two untethered snorkelers in the same body of water may act as observer/ assistant for each other if they remain within 50 ft (15.2 m) of each other.

b. Non-snorkeling observer/assistants shall wear a PFD and be equipped with a throw bag and/or ring buoy with at least 70 ft (21.3) of line, and must be capable of performing a rescue on the specific snorkeler(s) in an emergency.

30.G.08 Areas of extreme water velocity and turbulence will be avoided especially those immediately upstream from debris jams or bedrock outcrops.

30.G.09 Snorkelers will be provided with appropriate thermal protection.

30.G.10 Employees will be determined medically fit by a licensed physician <u>(DO or MD)</u> prior to snorkeling. This certification shall be signed by a physician <u>familiar with sports medicine</u>, and state that each snorkeler is physically and medically fit to perform snorkeling activities <u>according to commonly accepted sports medicine guidelines</u>. The Contractor shall submit such certification to the GDA for acceptance.

30.G.11 All snorkeling team members shall be certified in first aid and CPR. <u>Certification shall be in accordance with most recent Emergency Cardiovascular Care (ECC) guidelines, and/or American Heart Association or ARC standards</u>.

30.G.12 A first aid kit meeting the requirements of Section 3 will be available at each location where snorkeling is being performed. A means of securely transporting an unconscious person, such as a litter or stretcher, shall be provided when snorkeling is conducted in areas inaccessible to vehicles or boats.

30.G.13 A means of communication capable of contacting emergency services must be available at locations where snorkeling is performed.

30.G.14 Each snorkeler will be equipped with <u>a Dive Equipment Manufacturer's Association (DEMA) rated</u> professional grade mask, <u>fins,</u> snorkel <u>and snorkeling vest</u>.

30.G.15 A snorkeling protocol will be developed and included in the project file. It will contain as a minimum, the following:

a. An AHA for each specific snorkeling mission. Particular detail will be given to currents and other environmental considerations;

b. Records for snorkeling activities will be maintained and will include as a minimum:

<u>(1)</u> Snorkeler's annual physician certifications;

<u>(2)</u> AHAs, and

<u>(3)</u> A snorkeling plan that is based on the requirements of Section 30.A.1<u>5</u>.a-e. Contractors shall submit these to the GDA for acceptance by the DDC/SOH Dive Safety Officer a minimum of 10 days prior to start of work.

30.G.16 Snorkelers will wear apparel which provides appropriate protection from environmental conditions. The apparel must include fins or other appropriate foot protection.

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Appendix M: EM 385-1-1 Appendix G Manning Requirements

Manning Levels for Dive Teams

1. General. Manning level tables shown are a minimum. Actual manning levels may increase, as determined by the DDC, after considering the diving support systems, the task at hand, weather conditions, dive platform and location, and other factors. Team members may rotate through the dive team positions as long as the minimum manning levels are maintained and team members are qualified and accepted for the position.

2. SCUBA: Untethered, 0 to 100 ft (0 to 30.5 m).

a. Untethered SCUBA divers shall always be accompanied by another diver in continuous visual contact.

b. When depth of dive is 0-100 ft (0-30.5 m), the minimum dive team will be composed as shown in Table G-1:

TABLE G-1 Dive Team Composition SCUBA -Untethered, 0 to 100 ft (0 to 30.5 m)

Personnel	Number
Diving Supervisor	1
Divers (in visual contact)	2
Standby Diver*	1
TOTAL TEAM	4

3. SCUBA: Tethered with communications, 0 to 100 ft (0 to 30.5 m). When depth of the dive is 0-100 ft (0-30.5 m), the minimum dive team will be composed as shown in Table G
2:

Table G-2 Dive Team Composition SCUBA-Tethered with communications, 0 to 100 ft (0 to 30.5 m)

Personnel	Number
Diving Supervisor ***	1
Diver in Water	1
Standby Diver* (tethered with communications)	1
Tender	1
TOTAL TEAM	4

4. Surface Supplied Air: 0 to 100 ft (0 to 30.5 m).
a. When surface supplied air is being used as the diving mode, the minimum dive team will be composed as shown in Table G-3:

Table G-3 Dive Team Composition Surface Supplied Air, 0 to 100 ft (0 to 30.5 m) Within No Decompression Limits

Personnel	Number	Penetration Dive
Diving Supervisor ***	1	1
Diver in Water	1	2
Standby Diver*	1	1
Tender	1	2
TOTAL TEAM	4	6

b. Deploying the Standby Diver as a Working Diver. The Standby diver may be deployed as a working diver provided all of the following conditions are met:
  (1) Surface-supplied no-decompression dive of 60 fsw or less;
  (2) Divers are in close proximity, (based on site specific requirements), with unimpeded access to each other;
  (3) Divers have communications with each other at all times;

(4) No entanglement hazard exist;
(5) Prior to deploying the standby diver, the work area shall be determined to be free of hazards (ie., suctions, discharges) by the diver on the job site;
(6) The dive is NOT a penetration or confined space dive;
(7) Each diver has a full-time tender (which brings the minimum number of the teasm members to 5).

5. Surface Supplied Air: 101 to 190 ft (30.8 to 57.9 m).

When surface supplied air is being used as the diving mode, the minimum dive team will be composed as shown in Table G-4:

Table G-4 Dive Team Composition Surface Supplied Air, 0 to 100 ft Requiring Decompression and All Surface Supplied Air, 101 to 190 ft (30.8 to 57.9 m)

Personnel	Dives within no decompression limits	Dives requiring decompression	Penetration Dive
Diving Supervisor ***	1	1	1
Chamber Operator**	**/1	****/1	1
Diver in Water	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	5/6	5/6	8

6. Surface Supplied Mixed Gas Diving. For surface supplied mixed gas diving, to include OEA (Nitrox, ect), the minimum dive team will be composed as shown in Table G-5:

Table G-5 Dive Team Composition Surface Supplied Mixed Gas Diving

Personnel	Dives within no decompression limits	Dives requiring decompression	Penetration Dive
Diving Supervisor ***	1	1	1
Chamber Operator**	**/1	****/1	1
Diver in Water	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	5/6	5/6	8

Notes:
*** The standby diver will be rested and capable of performing emergency rescue assistance. When working is limited to no decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "NO Decompression Limits."**
**** The Competent Person/chamber operator may be any non-diving member of the dive team when the chamber is only for emergency use when diving within the no-decompression limits. Saturation diving requires that a life support technician will serve as the chamber operator.**
***** The supervisor may be the standby tender for dives under 100 ft (30,5 m).**
****** The Competent Person/chamber operator may be and non-diving member of the dive team if all diving ceases during chamber operation.**

Appendix C

Environmental Protection Plan

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Appendix C
Revision 0
Environmental Protection Plan for the Remedial Investigation

Iona Island Naval Ammunition Depot
Formerly Used Defense Site
Stony Point, Rockland County, New York

Prepared by
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November 2019

Appendix C

Environmental Protection Plan for the Remedial Investigation

Iona Island Naval Ammunition Depot
Formerly Used Defense Site
Stony Point, Rockland County, New York

Contract No. W912DR-15-D-0014 Delivery Order (DO) W912DR18F0587

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November 2019
Revision: 0
EA Project No. 63029587

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LIST OF ACRONYMS AND ABBREVIATIONS

AOCs	Area(s) of Concern
ASTs	Above ground storage tanks
CMP	Coastal Management Program
CZMA	Coastal Zone Management Act
DGM	Digital Geophysical Mapping
EA	EA Engineering, Science, and Technology, Inc., PBC
EPP	Environmental Protection Plan
FUDS	Formerly Used Defense Site
HTRW	Hazardous, Toxic, and Radioactive Waste
MC	Munitions constituents
MD	Munitions debris
MDAS	Material documented as safe
MEC	Munitions and explosives of concern
MRS	Munitions response site
NERR	National Estuarine Research Reserve
NY	New York
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
PIPC	Palisades Interstate Park Commission
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
SI	Site Inspection
UFP	Uniform Federal Policy
USDA	United States Department of Agriculture
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

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1. INTRODUCTION

This Environmental Protection Plan (EPP) has been developed to describe the approach, methods, and procedures that will be employed to minimize pollution, protect and conserve natural resources, restore damage, and control noise and dust during the Remedial Investigation (RI) at the Iona Island Naval Ammunition Depot Formerly Used Defense Site (FUDS) in Stony Point, Rockland County, New York (NY). Potential site resources and possible mitigation measures that can be used to avoid or lessen the impacts from RI activities are identified below.

The existing resources on the Iona Island Naval Ammunition Depot FUDS, as detailed in this EPP, were determined from the following documents:

- Final Archive Search Report for Iona Island, prepared by USACE – St. Louis District, dated March 1998.

- *Final Site-Specific Report for the Site Inspection of Iona Island* prepared by Alion Science and Technology (Alion), dated September 2006.

- *Final Historical Photographic of Iona Island - U.S. Army Geospatial Center, September 2018.*

- *Final Community Relations Plan for Iona Island Formerly Used Defense Site* prepared by EA Engineering, Science, and Technology, Inc., PBC (EA), dated March 2019.

Additional information pertaining to natural and cultural resources was obtained during a site visit (11 October 2018) and a Technical Project Planning (TPP) meeting (7 November 2018) among New York State Department of Conservation (NYSDEC), Palisades Interstate Park Commission (PIPC), U.S. Army Corps of Engineers (USACE), and EA that occurred at Bear Mountain State Park.

2. POTENTIAL SITE RESOURCES

Iona Island is in Stony Point, NY south of West Point and north of Manhattan, is part of Bear Mountain State Park, and is maintained by PIPC. RI activities pertaining to the 1903 Explosion Area Munitions Response Site (MRS-01) and 19 Hazardous (HTRW) Areas of Concern (AOCs) will be conducted at the Iona Island Naval Ammunition Depot FUDS (refer to Figures 2 and 11-3 of the Uniform Federal Policy [UFP] Quality Assurance Project Plan [QAPP]). MRS-01 is centered between former Buildings 209 and 210 (refer to Figures 11-1 and 17-2 of the UFP-QAPP).The AOCs include the locations/footprints of 16 former buildings, 4 former above-ground storage tanks (ASTs), a former dumping area, 2 former coal storage areas, and 3 former transformers where contaminants related to the facilities or from historic processes during the site's commission as an ammunition depot may be present.

The potential site resources listed below are discussed in the context of the Iona Island Naval Ammunition Depot FUDS based on available data.

2.1 THREATENED AND ENDANGERED SPECIES

To identify threatened and endangered (T&E) species, EA submitted a request to the NY Natural Heritage Program for a formal review of the project area on 11 December 2018. EA received an email on 4 April 2018 from the Natural Heritage Program stating that they would be providing a response to the request soon. As of 9 April 2018, no response had been received. However, a previous request was conducted by Alion in 2007 for the Site Inspection (SI) Report. Information from that response is provided in Table 2-1 below and includes both State and Federal status for the species identified that may potentially inhabit the Iona Island Naval Ammunition Depot FUDS. The letter also notes that the area includes several protected communities: Freshwater Tidal Marsh, Brackish Intertidal Mudflats, Brackish Tidal Marsh, Oak-tulip Tree Forest, Anadromous Fish Conservation Area, and Waterfowl Winter Concentration Area. In addition, EA searched the USFWS Environmental Conservation Online System for federally-listed T&E species in Rockland County, NY. The search revealed four species, which are also included in Table 2-1 below.

Table 2-1 Federal and State (New York) Listed Threatened and Endangered Species Potentially Present on Iona Island

Common Name	*Scientific Name*	Federal Status	State Rank	State Status
Plant Species of Special Concern				
Saltmarsh bulrush	*Bolboschoenus novae-angliae*	NL	S1	E
Terrestrial starwort	*Callitriche terrestris*	NL	S2S3	T
Long's bittercress	*Cardamine longyi*	NL	S2	T
Water pigmyweed	*Crassula aquatica*	NL	S1	E
Yellow Flatsedge	*Cyperus flavescens*	NL	S1	E
Saltmarsh spikerush	*Eleocharis uniglumis var. halophila*	NL	S2	T
Small-flowered crowfoot	*Ranunculus micranthus*	NL	S3	T
Spongy arrowhead	*Sagittaria montevidensis var. spongiosa*	NL	S2	T
Saltmarsh aster	*Symphyotrichum subulatum*	NL	S2	T
Small whorled pogonia	*Isotria medeoloides*	T	-	NL
Wildlife Species of Special Concern				
Indiana bat	*Myotis sodalist*	E	-	NL
Northern long-eared bat	*Myotis septentrionalis*	T	-	NL
Bald eagle	*Haliaeetus leucocephalus*	T	S2S3B,S2N	T
Bog turtle	*Clemmys muhlenbergii*	T	S2	E
Timber rattlesnake	*Crotalus horridus*	NL	S3	T
Shortnose sturgeon	*Acipenser brevirostrum*	E	S1	E
Atlantic sturgeon	*Acipenser oxyrinchus*	C	S1	P
Least bittern	*Ixobrychus exilis*	NL	S3B,S1N	T
Kentucky warbler	*Oporornis formosus*	NL	S2	P
Fence lizard	*Sceloporus undulatus*	NL	S1	T

Plant Species Ranks

S1 – Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation

S2 – Very rare; usually between 6 to 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated

S3 - Rare to uncommon; usually between 21 to 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances

Wildlife Species Ranks

S1 – Highly state rare, critically imperiled in New York
S2 – State rare; imperiled in New York because of rarity
S3 – Rare to uncommon
B – Animal is migratory, and rank refers only to the breeding status
N – Animal is migratory, and rank refers only to non-breeding status.

Key to Codes

T – threatened
NL – not listed
SC – special concern
E – endangered
P – protected
C - candidate

Sources: NYSDEC. NY Natural Heritage Program. Letter to Corinne Shia dated 11 October 2007.

2.2 RESEARCH AREAS AND PROJECTS

During the 11 October 2018 Site Visit, the Science Director at PIPC noted that research projects are conducted on Iona Island. He stated that long-term research sites are potentially located within the Iona Island Naval Ammunition Depot FUDS boundary. Research teams include personnel from Hudson River National Estuarine Research Reserve (NERR), U.S. Department of Agriculture (USDA), and Cornell University. Studies include an eastern box turtle telemetry survey and a rare plant species monitoring program. There is also an active invasive species removal program to reduce the amount of *Phragmites* spp. on the island. Various walking tours, naturalist groups, and park education groups regularly visit the island; access is by permit only.

2.3 WATER RESOURCES

Iona Island is bordered on the east by the Hudson River; on the northwest by the mouth of Doodletown Bight, an expanse of shallows and mudflats; on the west and southwest by Iona Island Marsh, a tidal marsh that occupies one mile between Iona Island and the mainland (refer to Figures 2 and 11-3 of the UFP QAPP). Iona Island is separated from the mainland by Snake Hole Creek on the south and Doodletown Brook on the west and north. There are no surface water bodies or drainages on the land-portion of the island within the FUDS boundary, however many areas of the island and adjoining marshes are influenced by the Hudson River.

The Hudson River originates in the Adirondack Mountains of Upstate New York, and flows southward 315 miles to the Atlantic Ocean at New York Harbor, between New York City and Jersey City. Maximum river depths are found in the Hudson Highlands between West Point and Peekskill, New York, with the deepest point of 196 ft at West Point (Yozzo et al. 2005). The lower half of the Hudson River from Troy to New York Harbor, a distance of 125.5 miles, is an estuary (drowned river valley) affected by semidiurnal tides, with two highs and two lows occurring within a 25-hour period (Yozzo et al. 2005). The tidal range averages approximately 2.9 feet (Yozzo et al. 2005).

Salinity zones in the Hudson are determined by a combination of hydrographic factors, primarily the tidal surge of saline water upriver from the Atlantic Ocean and the magnitude of freshwater flow into the upper estuary. Freshwater flow in the Hudson estuary follows a typical seasonal pattern, with highest flow during the spring and lowest flow during late summer and early fall under an average runoff regime the salt front (0.5 parts per trillion) reaches Newburgh by late summer/early fall. During conditions of high freshwater runoff, usually during spring, the salt front may be pushed downriver as far as the Bronx (Yozzo et al. 2005).

Iona Island is located 41.2 miles upstream from New York Harbor and approximately 30 miles upstream of Bronx, NY. The section of the Hudson River at Iona Island is narrow and deep, with strong currents and a rocky bottom substrate. The width of the Hudson River at Iona Island is approximately 0.3 mile east of Iona Island, and the river in this area has a depth of approximately 165 ft. Tidal influence at Iona Island is approximately 3.5 ft, and shorelines may not be accessible during high tide conditions (Alion 2008).

Doodletown Brook, located west of Iona Island, is the principal tributary to Iona Island Marsh and drains an area of approximately 2.9 square miles (Yozzo et al. 2005). Doodletown Brook flows eastward into Doodletown Bight and then to the Hudson River, near the northern end of Iona Island. Snake Hole Creek originates in the low marshes southwest of Iona Island and flows southwesterly, then southeast, and finally east to the Hudson River. The Creek divides Iona Island Marsh into Salisbury Meadow on the west and Ring Meadow, on the east side.

Groundwater at and in the vicinity of Iona Island is found in both overburden and underlying bedrock. Groundwater in overburden at Iona Island was encountered at a depth of 2 ft near the former dumping area between Iona Island and Round Island during the October 1996 soil sampling event; likely because bedrock is close to the surface and infiltration, where possible, is very slow (Greeley-Polhemus 1997). Shallow groundwater is likely influenced by the Hudson River.

Crystalline bedrock of the Hudson Highlands acts as a relatively poor aquifer. Groundwater in the gneiss and granitic rocks only occurs in fractures and joints (Heisig 2010). Bedrock groundwater at Iona Island is likely encountered at depths greater than 6 ft as based on the rock outcrop soil description reported in the Rockland County Soil Survey (Bonnell 1990).

Groundwater recharge is primarily from infiltration of local precipitation, with downward seepage of water through overburden into underlying bedrock and/or direct infiltration of precipitation on exposed bedrock surfaces. Upward seepage of water from bedrock also recharges surficial deposits in low-lying areas. Shallow groundwater flow in surficial deposits and weathered bedrock likely follows topography, with discharge to surface water bodies (i.e., Hudson River). Due to the crystalline nature of the bedrock, groundwater flow is restricted to joint and fracture systems that generally trend northeast-southwest (Olcott 1995).

Groundwater usage in the Hudson Highlands is largely limited to domestic wells along the periphery of the parklands. Maximum yields of wells completed in the crystalline rocks rarely exceed 70 gallons per minute, and limited aquifer storage in crystalline rock makes such wells susceptible to decreased yields during dry periods unless they are in hydraulic connection with surface water (Heisig 2010).

2.4 CULTURAL AND ARCHEOLOGICAL RESOURCES

The New York State Historic Preservation Office was contacted about planned remedial investigation activities at Iona Island via letter in January 2019 in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966. On 28 March 2019, the State Historic Preservation Office provided notification of concurrence with the determination that the project activities will have no adverse effect upon cultural resources in or eligible for inclusion in the National Registers of Historic Places.

2.4.1 Archaeological Resources

A complete archeological survey of Iona Island has not been performed to date. However, it is unlikely that any undisturbed archeological site will be present at Iona Island due to the historical demolition of buildings and reworking of soil on the island.

2.4.2 Historic Buildings and Structures

No historic sites have been identified as eligible for listing on the National Register of Historic Places. No suspected or known cultural resources have been identified at Iona Island. In the instance that the location of a known cultural, archaeological, and/or historically significant area is identified, field crews will be informed of the location prior to the start of work. Any work conducted near known areas of significance will be coordinated with the Installation's archaeologist. Should any historic or archeological resources be uncovered during the course of the RI, work will cease in the area where resources were uncovered, and the State Historic Preservation Office will be contacted. Work will resume in the area after approval from PIPC and USACE.

2.5 COASTAL ZONE

Iona Island is situated within the New York Coastal Zone. Activities proposed for this RI will occur within the New York Coastal Zone and will include land-based, water-based, and potentially, aerial geophysical surveys. Shallow excavations for single anomalies will be conducted, and deep excavations (15-20 feet below ground surface or below sediment surface) will be conducted if burial pits are identified. Disturbance to coastal areas will be kept to a minimum and activities will be conducted in compliance with New York Coastal Zone regulations.

New York's State's Coastal Management Program (CMP) is administered by the New York State Department of State (NYSDOS) and carried out in partnership with local governments and State and Federal agencies. The CMP is based on a set of 44 coastal policies that guide coastal management actions at all levels of government in the State to ensure the appropriate use and protection of coasts and waterways.

The Federal regulations that implement the consistency provisions of the Coastal Zone Management Act (CZMA) are presented in 15 CFR Part 930. These regulations establish the procedures to be followed to ensure that Federal agency activities are consistent with the enforceable policies of the CMP. These regulations apply to actions taken by, or conducted on behalf of, Federal agencies. The types of activities covered by the CZMA include activities requiring authorizations or other forms of approval from Federal agencies, activities involving financial assistance from Federal agencies, and outer continental shelf activities. Any Federal agency considering undertaking an activity is required to submit a consistency determination with other necessary information and data to the NYSDOS. The Department of State reviews a Federal agency's proposed activity and consistency determination and renders its own decision regarding the consistency of the activity with the CMP.

USACE submitted a coastal policy analysis to the New York State Coastal Management Program on 4 November 2019 regarding the plan to perform work in the Hudson River along Iona Island. On 22 November 2019, the Department of State provided a letter of concurrence with the USACE's consistency determination regarding the consistency of the proposed activities to perform both land-based and subsurface investigations at Iona Island.

2.6 VEGETATION

Native vegetation within the marsh is dominated by narrow leaf cattail (*Typha angustifolia*) with common reed (*Phragmites* spp.) and swamp rose mallow (*Hibiscus moscheutos*). Crack willow (*Salix fragilis*) is present at the mouth of Doodletown Brook within the tidal swamp. Compaction of soil, salt water intrusion, and site disturbance have resulted in a significant presence of invasive species (estimated at 60 percent of the vegetation on the island). Recent wetland restoration has been conducted on site, with approximately 50 percent of the marsh restored from invasive species (including *Phragmites* spp.) to native vegetation such as cattails (Bluestone 2018).

The upland terrestrial areas of the island consist of deciduous, rocky woodland communities including oaks (*Quercus* spp.), ashes (*Fraxinus* spp.), birches (*Betula* spp.), willows (*Salix* spp.), red maple (*Acer rubrum*), and elms (*Ulmus* spp.). The woodlands are maintained for their value as cover, perch sites, and buffer zones.

2.7 WASTE DISPOSAL SITES

Based on the findings from the 2008 SI, there are no confirmed munitions debris (MD) burial areas on Iona Island (Alion 2008). One former dumping area (AOC #16 – Area D) was identified between Iona and Round Island.

This RI is being conducted, in part to determine if additional munitions and explosives of concern (MEC)/MD waste disposal/burial areas are present within the RI areas. Geophysical investigations will be conducted along the shoreline and within the AOCs to search for munitions related disposal/burial areas and targets areas.

3. MITIGATION PROCEDURES

3.1 COORDINATION WITH THE PIPC

Action will be taken during the RI field activities to minimize or mitigate any adverse impact to the environment. EA will work closely with the Science Director at PIPC to minimize impacts to the environment. The Science Director has provided information on the existing natural and cultural resources present at Iona Island for inclusion within this EPP. During the field kickoff meeting, EA will work with PIPC's Science Director to properly train the field team in identifying and avoiding these natural and cultural resources.

3.2 BURNING ACTIVITIES

No burning activities will be completed during the RI.

3.3 DUST AND EMISSIONS CONTROL

RI activities will generate little to no dust or emissions; therefore, a dust control plan will not be required.

3.4 SPILL CONTROL AND PREVENTION

Minimal amounts of chemicals will be brought onsite during the field activities. These will be limited to fuel (i.e., gasoline, diesel, etc.) for field equipment and decontamination fluids. Vehicle refueling will be completed at commercial offsite facilities. All attempts will be made to refuel field equipment on paved locations at or near MRS-01 and AOCs. A spill kit will be available during refueling operations for field equipment. Field procedures will focus on minimizing or preventing spills during field activities; however, if a spill of hazardous chemicals occurs, field personnel will contain the spill and contact the PIPC point-of-contact, the Science Director. Spill management and resolution will be conducted according to PIPC guidelines.

3.5 ACCESS ROUTES

EA will use established roadways (dirt or paved) to the extent possible to gain access to the RI areas. Within the RI areas, field personnel will strive to confine motorized traffic to established access routes to reduce potential impacts to surface topography and vegetation.

3.6 VEGETATION PROTECTION AND RESTORATION

In order to minimize potential impacts to federal and state listed plants and animals, EA will consult with the PIPC and provide site-specific training to the field team before beginning any vegetation removal activities at MRS-01 and the AOCs. Field personnel will be trained to identify sensitive species and their habitat.

Based on observed site conditions, some vegetation may need to be removed from the AOCs. Vegetation will generally be hand-cut, using man-portable brush cutters.

If necessary, extensive vegetation clearing or use of mechanical equipment such as a skid-steer track loader with brush mower attachment will be discussed with the PIPC in advance for approval. No vegetation restoration is anticipated due to the thickness of the existing vegetation and the minimal vegetation clearance that is anticipated to occur.

3.7 THREATENED AND ENDANGERED SPECIES

The Atlantic sturgeon and shortnose sturgeon live primarily in the ocean but migrate to coastal rivers for spawning in April to June (NYSDEC 2019). In New York, spawning and nursery grounds for juveniles are located in the Lower Hudson River (refer to Table 1-1).

Bald eagles primarily use Iona Island during the coldest winter months (mid-November to mid-March), and typically stay on the east side of the island, along the shoreline with the Hudson River. The least bittern is a marsh bird with an active breeding window from April through July.

Currently, both off- and on-land activities (external geophysical, HTRW sampling, and advanced digital geophysical mapping [DGM], and diving) are planned for fall/winter.

The temporal boundary for the investigation will be phased and include multiple mobilizations to account for seasonal considerations such as vegetation (HTRW sampling and DGM and AGC will be performed during spring prior to marsh and island growth), avoidance of avoid the key time periods and sensitive locations for wintering bald eagles (mid-December thru early March, depending on winter severity) and marsh bird breeding (the nesting/fledging of the least bittern in the marsh grasses to the west of Iona Island during mid-April – mid-July), and Hudson River tides (e.g., diving will be performed during slack tide when possible for safety considerations). Field activities will be conducted on a schedule that avoids the key time periods and sensitive locations indicated for these species to the extent practicable. If work needs to be conducted during key time periods, additional coordination will be conducted with Bear Mountain State Park POC to allow access at the tail ends of these periods. PIPC’s Science Director will provide a guide to direct the field team and avoid unnecessary disturbance.

EA will also provide site-specific training to the field team before beginning any activities that may be in a potential bald eagle wintering area or least bittern nesting site. Field personnel will be trained to identify and avoid sensitive species (e.g., least bittern, bald eagles) and their habitats to ensure T&E species are not impacted during the RI. If sensitive species are identified in a work area, the field team will temporarily stop work and consult with PIPC’s Science Director.

3.8 WATER RUN-ON AND RUN-OFF CONTROL

If the potential exists for encountering surface water within land-based areas where soils have been exposed (e.g., following vegetation removal, intrusive investigation of anomalies, or post-detonation), appropriate precautions will be used to control water run-on and run-off during completion of field activities. This may include the use of silt fencing or other best management practices, as appropriate.

3.9 EQUIPMENT DECONTAMINATION

Non-disposable, reusable equipment that may directly or indirectly contact samples will be decontaminated between sampling locations in accordance with EA's SOP 005. This equipment includes, but is not limited to, incremental sampling tools used to collect incremental soil samples; drilling augers used during soil boring advancement; ponar dredges used during sediment sampling; stainless steel scoops or bowls used to composite discrete soil or sediment samples; and water level meters used to measure water depths in temporary wells.

Reusable personal protective equipment (PPE) or clothing that becomes contaminated during site work will be appropriately cleaned before reuse or will be disposed of and replaced.

3.10 WASTE MANAGEMENT PLAN

Expendable waste used in completing the sampling (including used PPE and general trash, dedicated acetate sleeves, temporary well casing and tubing, plastic spoons/scoops, etc.) will be bagged and properly disposed of as general debris/trash.

Decontamination wash water (deionized water and non-phosphate soap) will be limited and will be contained in 5-gallon buckets. Whether or not the disposal of wash water offsite is required will be determined among project stakeholders, and if necessary, the wash water will be characterized prior to disposal.

Soil cuttings generated during soil boring advancement will be returned to borings following removal of temporary wells. Purge water generated during groundwater sampling and decontamination fluids used during equipment decontamination tasks will be discarded to ground surface.

3.11 POST-ACTIVITY CLEAN-UP

Solid waste generated during the RI will be removed from the site on an as needed basis and will be disposed of as general refuse (as discussed in Section 2.2). MDAS will be removed after RI activities have been completed and prior to leaving the site. Any material potentially presenting an explosive hazard or MEC that are found during the RI will also be disposed of by EA. MEC disposal operations will include the demolition of suspected MEC and the subsequent removal of MD and backfilling of holes resulting from the detonation. No post-detonation sampling for residual munitions constituents (MC) will occur as it is assumed that all energetics will be consumed upon detonation.

3.12 AIR MONITORING PLAN

Exposure to volatiles or particulates in air via inhalation is not significant because the site is vegetated. Based on the site history, site conductions, and the nature of the proposed RI activities (e.g., digging target anomalies and soil sampling), an Air Monitoring Plan is not necessary.

4. REFERENCES

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Appendix D

Explosives Management Plan

Appendix D
Revision 0
Explosives Management Plan for the Military Munitions Response Program Remedial Investigation

Iona Island Naval Ammunition Depot
Formerly Used Defense Site
Stony Point, Rockland County, New York

Prepared by

EA Engineering, P.C. and Its Affiliate
EA Science and Technology
6712 Brooklawn Parkway, Suite 104
Syracuse, New York 13211

November 2019

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Appendix D

Explosives Management Plan for the Military Munitions Response Program Remedial Investigation

Iona Island Naval Ammunition Depot Formerly Used Defense Site Stony Point, Rockland County, New York

Contract No. W912DR-15-D-0014

Prepared by

EA Engineering, P.C. and Its Affiliate
EA Science and Technology
6712 Brooklawn Parkway, Suite 104
Syracuse, New York 13211

EA Project No. 63029587
November 2019
Version: Final

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LIST OF ACRONYMS AND ABBREVIATIONS

BATF	Bureau of Alcohol, Tobacco, Firearms, and Explosives
COR	Contracting Officer's Representative
EA	EA Engineering, Science, and Technology, Inc., PBC
FUDS	Formerly Used Defense Site
MEC	Munitions and explosives of concern
MPPEH	Material potentially presenting an explosive hazard
RI	Remedial Investigation
SUXOS	Senior Unexploded Ordnance Supervisor
UXO	Unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

This Explosives Management Plan has been prepared in accordance with United States Army Corps of Engineers Engineering Manual 200-1-15, *Technical Guidance for Military Munitions Response* Actions, dated 30 October 2018, to support the remedial investigation (RI) at the Assateague Island Formerly Used Defense Site (FUDS). The primary objective of this RI is to characterize the nature and extent of potential munitions and explosives of concern (MEC) at the Iona Island Naval Ammunition Depot FUDS Stony Point, Rockland County, New York. During execution of the RI, demolition support may be required. If necessary, EA Engineering, Science, and Technology, Inc., PBC (EA) will perform MEC disposal using detonation.

1. LICENSES/PERMITS

EA has a current Type 33 User of High Explosives License from the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATF) to purchase and use explosives. This license will be available for federal, state, or local inspection during RI operations.

A State Blaster License is required by the State of New York Department of Labor to those who sell explosives, own, transport or possess explosives. Thus, EA will obtain a current State Blaster License to perform disposal activities during RI operations.

2. EXPLOSIVES ACQUISITION

Explosives acquisition, including a description and estimate of quantity, the acquisition source, and a summary of the explosives to be acquired, is summarized in the subsections below.

2.1 ACQUISITION SOURCE

EA will use the services of a licensed commercial explosives vendor (i.e., Tripwire Operations Group) to support the project on an as needed basis for the supply of donor explosives. The Senior Unexploded Ordnance Supervisor (SUXOS) will be the only person authorized to request and receive donor explosives from the licensed commercial explosives vendor.

2.2 PROPOSED EXPLOSIVES AND QUANTITIES

The delivery of donor explosives will be determined on an as needed basis. Quantities will be based on the minimum amount of donor explosive required to safely and effectively dispose of discovered MEC and/or material potentially presenting an explosive hazard (MPPEH). The following types of donor explosives may be used to conduct disposal operations: jet perforators, pentolite boosters, detonation cord, and blasting caps.

3. INITIAL RECEIPT

The licensed commercial explosives vendor is responsible for permits and documentation required by federal, state, and local regulations regarding the transportation of explosives to the location where EA will take custody of the explosives. Only the SUXOS may sign for explosives received from the explosives vendor.

3.1 INITIAL RECEIPT PROCEDURE

The SUXOS maintains documentation concerning the receipt of explosives. The SUXOS and the Unexploded Ordnance Quality Control Specialist (UXOQCS) will conduct a thorough inventory prior to assuming accountability for the material. The SUXOS and UXOQCS will check and record the type, quantity, and lot number of each explosive item against the manifest. Copies of records will be maintained onsite by the SUXOS and will be available for inspection by authorized agencies. Lot numbers will be used to track explosive items until the items are expended.

3.2 EXPLOSIVES SHIPPED AND RECEIVED DISCREPANCY

In the event that a discrepancy occurs between the quantities of explosives shipped and received, the SUXOS will immediately contact the explosives vendor, the EA Project Manager, and the EA Munitions Response Technical Advisor (BATF Responsible Person), Rick Hanoski. It will be the responsibility of the explosives vendor to rectify the shipment discrepancy. The explosives vendor will be responsible for providing copies of revised shipping documents. Only the actual quantity of explosives received will be signed for on the bill of lading at the time of delivery.

4. STORAGE

Commercial explosives will not be stored onsite. Donor explosives will be ordered on an as needed basis for the disposal of discovered MEC/MPPEH, per the approved Explosives Site Plan If it becomes necessary to site and operate a Type II magazine to store donor explosives or MPPEH, then a revision to this Explosives Management Plan will be submitted to the Contracting Officer's Representative (COR) for approval.

5. TRANSPORTATION

Transportation of explosives and MPPEH will be conducted in accordance with applicable sections of 49 Code of Federal Regulations Parts 172, 397, as well as state and local regulations. For transportation of explosives and MPPEH onsite, EA will comply with the following:

- The load will be well braced and covered with a fire-resistant tarpaulin, except when unloading or loading.
- Vehicles transporting explosives will be inspected daily using the Explosive Vehicle Inspection Sheet. Vehicles will be properly placarded in accordance with 49 CFR Part 172.

- Explosives will be transported in closed vehicles whenever possible. When using an open vehicle, explosives will be covered with a flame-resistant tarpaulin (except when loading/unloading).

- Vehicle engine will not be running when loading/unloading explosives.

- Beds of vehicles will have a wooden bed liner, chocking material, or sandbags to protect the explosives from contact with the metal bed and fittings.

- Vehicles transporting explosives will have a first aid kit, two 10-pound B C-rated fire extinguishers, and communications capability.

- Initiating explosives, such as blasting caps, will remain separated at all times. Blasting caps may be transported in the same vehicle as long as they are in a separate container and secured away from other items.

- Compatibility requirements will be observed.

- Only Unexploded Ordnance (UXO) Technicians II and above will transport explosive materials.

- Operators transporting explosives will have a valid driver's license or commercial driver's license with hazardous material endorsement, as applicable

- Drivers will comply with posted speed limits. Vehicles transporting explosives off-road will not exceed 25 miles per hour.

Vehicle operators will either be EA or vendor employees who are licensed, trained, and informed of the explosive hazards involved with the cargo. Prior to movement, the driver will visually inspect the explosive-laden vehicle to confirm the load is properly secured and safe to move; the SUXOS or UXO Safety Officer (UXOSO) will provide oversight during loading. The cargo will be checked to confirm containers are loaded, blocked, braced, tied down, or otherwise secured to the vehicle body to prevent movement. If using a vehicle with an open body, a closed container to contain the explosives will be secured to the bed of the vehicle.

The UXOSO will verify that the following general safety precautions are observed during transport operations:

- Explosives will not be transported in the passenger compartment of a vehicle
- Explosive-laden vehicles will not be left unattended
- Personnel will not be permitted to ride on or in the cargo compartment
- Smoking in and around vehicles transporting explosives is prohibited
- Refueling of vehicles will be conducted without the explosive cargo loaded.

6. RECEIPT PROCEDURES

Explosives received will be inventoried by the SUXOS and UXOQCS. The SUXOS will enter the type, quantity, and lot numbers into the Explosives Accountability Log (standard operating procedure 12 in Appendix C of the Quality Assurance Project Plan). The Explosive Accountability Log certifies that the explosives were expended as intended in the disposal process. The Explosive Accountability Log will document each disposal process and will be maintained by the SUXOS.

7. EXPLOSIVES INVENTORY

Inventory accounting will be conducted upon initial receipt. All explosives will be expended the same day as received.

8. INSPECTION OF MAGAZINES

EA will not operate an explosives storage magazine on Iona Island FUDS.

9. EXPLOSIVES THEFT

If it is confirmed that explosives are missing, the SUXOS will notify the EA Project Manager, and the EA Munitions Response Technical Advisor (BATF Responsible Person), Rick Hanoski. The EA Project Manager who will notify the USACE Project Manager as well USACE Safety Manager Paul Greene and the BATF (1-888-283-2662) and immediately begin an investigation. The COR will be notified by telephone immediately. A written report will be submitted within 24 hours.

10. RETURN OF EXPLOSIVES

All donor explosives will be expended the same day as received.

Appendix E

Explosives Site Plan

DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD
4800 MARK CENTER DRIVE, SUITE 16E12
ALEXANDRIA VIRGINIA, 22350

JUN 11 2019

DDESB-PE

MEMORANDUM FOR DIRECTOR, U.S. ARMY DEFENSE AMMUNITION CENTER
ATTENTION: ATCL-ACE

SUBJECT: DDESB Approval of Explosives Site Plan, Remedial Investigation, Former Naval Ammunition Depot, Iona Island, NY [USATCES MEC File Number 7773]

References: (a) DAC ATCL-ACE Memorandum of 6 May 2019, Subject: Request DDESB Approval of Explosives Site Plan (ESP), Iona Island Former Naval Ammunition Depot, Iona Island, NY, May 2019. [USATCES MEC File Number 7773]

(b) Defense Explosives Safety Regulation 6055.09, Edition 1, 13 January 2019

(c) DDESB Technical Paper 15 (TP-15), Revision 3, "Approved Protective Construction" May 2010

The Department of Defense Explosives Safety Board (DDESB) Staff has reviewed the subject explosives site plan (ESP) forwarded by reference (a) against the requirements of reference (b). Based on the information provided, approval is granted for removal and destruction of material potentially presenting an explosive hazard (MPPEH) and munitions and explosives of concern (MEC) at Former Naval Ammunition Depot, Iona Island, NY. This approval is based on the following:

a. The efforts addressed in this ESP involve manual unintentional detonation operations and intentional detonations supporting munitions response actions within the Munitions Response Site (MRS) Iona Island.

b. The DDESB acknowledges that reference (b) currently does not provide criteria to establish the minimum separation distance (MSD) for personnel in/under the water from intrusive (i.e., unintentional and intentional detonation) explosive operations conducted underwater. Consequently, the DDESB is unable to approve intrusive underwater explosive operations. The Army, per reference (a), has established criteria addressing intrusive underwater explosive operations within MRS Iona Island and will make an informed risk decision associated with those operations in accordance with Army policy.

c. The results of this ESP will be used to prepare an explosives safety submission per reference (b).

d. The munition with the greatest fragmentation distance (MGFD) for the terrestrial portions of the MRS Iona Island is the Mk II Grenade; the minimum separation distance (MSD) for teams for manual unintentional detonation operations is 20 feet (ft) based on K40 of the MGFD; the MSD for nonessential personnel from manual unintentional detonation operations is 62 ft based on the hazardous fragment distance of the MGFD; and the MSD for all personnel from intentional detonations is 521 ft based on the maximum fragment distance of the MGFD.

e. Collection points and consolidated shots are authorized provided the Army ensures usage of reference (c), paragraph C6.2.7.5.

f. The use of sandbags and earth tamping is authorized as an engineering control for intentional detonations involving the MEC identified in reference (a) provided the Army ensures usage per reference (c), paragraph C6.2.7.5.

g. One ATF Type II aboveground magazine is approved to store demolition materials up to 30 pounds net explosives weight of hazard division (HD) 1.1 and mission essential quantities of HD 1.4. The applicable inhabited building distance is 561 ft and the public traffic route distance is 337 ft.

h. Prior to initiation and through completion of on-site explosives operations, all nonessential personnel will be evacuated and prevented from entering any area/facility encumbered by the MSD required for the operation being conducted, or explosives operations will be suspended if nonessential personnel enter the MSD.

i. MPPEH will be inspected and classified as material documented as safe prior to release to the public.

If changes occur during or after completion of this effort that could increase explosive hazards to site workers or the public due to the presence of military munitions at the site, an amendment to this ESP must be submitted to DDESB for review and approval.

The point of contact for this action is Ms. Kristene Bigej, (571) 372-6705, DSN 372-6705, E-mail address: kristene.a.bigej.civ@mail.mil.

THIERRY L. CHIAPELLO
Executive Director

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF

CEHNC-EMM 3 May 2019

MEMORANDUM FOR US Army Technical Center for Explosives Safety, Explosives Safety Knowledge, OE and Chemical Division, (ATCL-ACE/ Mr. Chad Williams), Building 35, 1C Tree Road, McAlester, OK 74501-9053

SUBJECT: Explosives Site Plan (ESP), Iona Island Former Naval Ammunition Depot, Iona Island, NY, May 2019.

1. References:

a. ER 385-1-95, Safety and Health Concerns for Munitions and Explosives of Concern (MEC) Projects, March 2007.

b. Defense Explosives Safety Regulations (DESR) 6055.09, Edition 1, January 2019.

2. This memorandum constitutes Direct Reporting Unit approval for US Army Corps of Engineers participation per reference 1a.

3. If you have any questions, please contact Mr. Walt Zange at (256) 895-1586 or Mr. Jeff Barker at (256) 895-1513.

NEBELSICK.JOHN.D.1231361207 Digitally signed by NEBELSICK.JOHN.D.1231361207 Date: 2019.05.06 07:59:56 -05'00'

Encl

SANDRA M. ZEBROWSKI, P.E.
Director, Environmental and
Munitions Center of Expertise

CF: electronically w/o encl

DEPARTMENT OF THE ARMY
US ARMY DEFENSE AMMUNITION CENTER
1 C TREE ROAD
MCALESTER OK 74501-9053

ATCL-ACE 6 May 2019

MEMORANDUM FOR Department of Defense Explosive Safety Board (DDESB-PE/MS. Bigej), 4800 Mark Center Drive, Suite 16E12, Alexandria, VA 22350-3606.

SUBJECT: Request DDESB Approval of Explosives Site Plan (ESP), Iona Island Former Naval Ammunition Depot, Iona Island, NY, May 2019. [USATCES MEC File Number 7773]

1. References:

a. Memorandum, Department of the Army, Corps of Engineers, Huntsville, AL, CEHNC-EMM, 3 May 2019, Subject: Explosives Site Plan (ESP), Iona Island Former Naval Ammunition Depot, Iona Island, NY, May 2019. (Enclosed).

b. DoD 6055.09-M, Ammunition and Explosives Safety Standards, date varies by Volume, Administratively Reissued 4 August 2010. (Defense Explosives Safety Regulation (DESR) 6055.09, Edition 1, 13 January 2019.)

c. Department of the Army Pamphlet (DA PAM) 385-64, Ammunition and Explosives Safety Standards, 24 May 2011, RAR 10 October 2013.

d. Memorandum, SAIE-ESOH, 16 September 2013, Subject: Munitions Response Actions – Minimum Separation Distance (Relative to Impulse Water Pressure) from Underwater Detonations.

2. Reference 1.a. with enclosed ESP, is provided for DDESB review and approval in accordance with reference 1.b. and 1.c. USATCES has reviewed the ESP and recommends approval.

3. The purpose of this ESP is to conduct surface and subsurface manual investigative action to depth of detection to characterize the former Iona Naval Ammunition Depot. A portion of the munitions response site is under water and as such, operations will comply with reference 1.d. for underwater safe separation distances.

4. The POC is Ms. Robin Jett, ATCL-ACE, DSN 956-8002, or (918) 420-8002, robin.e.jett4.civ@mail.mil. Alternate POC Mr. Chad Williams, (918) 420-8044, DSN 956-8044, chad.t.williams7.civ@mail.mil.

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Encl

CARL A. THOMAS
Director, U.S. Army Technical Center for
Explosives Safety

CF: DACS-SF/Mr. Patton

REMEDIAL INVESTIGATION (RI)
EXPLOSIVES SITE PLAN (ESP)
FORMERLY USED DEFENSE (FUDS)

Iona Island
Former
Naval Ammunition Depot

Iona Island, New York

May 2019

PREPARED BY
EMDC BALTIMORE DISTRICT, USACE

TABLE OF CONTENTS

1. **Site:**
   - **a.** Name: Iona Island Former Naval Ammunition Depot
   - **b.** State: Iona Island, NY

2. **Anticipated Dates:**
   - **a.** Start: July 2019

3. **Purpose:**

   A manual Remedial Investigation is required at this location based on the historic ordnance activities and the Site Investigation (SI) findings in order to further characterize the former Iona Naval Ammunition Depot.

4. **Site Background and Current Conditions:**

   The former Iona Island Naval Ammunition Depot is located on Iona Island and Round Island in the Town of Stony Point, County of Rockland, New York. United States Naval Department used the property from 1900 to 1947 as an ammunition depot.

   In 1903, an explosion occurred between Shell Houses 3 and 4 on Iona Island. Some of the contents of the explosion are thought to have been thrown out from the point of the explosion as far as 1,250 feet for a total of 124 acres. A hand grenade was found in the mid 1980's and destroyed by a team from Ft. Smith.

5. **Executing Agencies:**
   - **a.** US Army Corps of Engineers (USACE) – Baltimore District
   - **b.** Army Environmental Command

6. **Scope of Investigative Action:**

   A surface and subsurface manual investigative action to depth of detection is required for this RI.

7. **Safety Criteria:**
   - **a.** The munition with the greatest fragmentation distance (MGFD) for the Munitions Response Sites (MRS) is identified in Table 7-1. If munitions of explosive concern (MEC) with a greater fragmentation distance are encountered during the course of this investigation, the Minimum Separation Distances (MSD) will be adjusted in accordance with DDESB Technical Paper 16 and the Fragmentation Data Review Forms. The work will continue with an ESP amendment submitted and the quantity distance (QD) arcs will be adjusted accordingly.

   - **b.** See Appendix B for Fragmentation Data Review Form.

   - **c.** See Table 7-1 for Minimum Separation Distances.

d. Any occupied buildings public, roadways or waterways in the MSD areas during MEC operations will be evacuated and/or roadways/waterways blocked to prevent non-essential personnel from entering during the conduct of MEC operations. In the event that roadways/waterways cannot be blocked, guards will be posted and work halted if non-essential personnel enter the MSD. MEC operations will not resume until non-essential personnel have exited the MSD.

e. The Army will establish underwater QD criteria.

f. Only one team will be working in the MRS during underwater investigations.

Table 7-1
Minimum Separation Distances

Munitions Response Site (MRS)	Munitions with the Greatest Fragmentation Distance (MGFD)	MSD (ft)[1]			
		Unintentional Detonations		Intentional Detonations	
		Hazardous Fragment Distance (HFD)	Team Separation Distance (K40)	Without Engineering Controls (MFD)	Using Engineering Controls
Fragmentation Grenade Range	MK II Grenade	62	20	521	200[1]

Note: 1. The sandbag throw distance is 25 ft., however a 200 ft. distance around the demolition operation will be secured for safety

8. Methods of Disposal:

a. Donor explosives will be stored in a Bureau of Alcohol, Tobacco, and Firearms, (ATF) Type 2 magazine with attached detonator box. The net explosive weight (NEW) at the potential explosion site (PES) will be limited to 30 pounds of HD 1.1 explosives. The PES will be cleared at least the K11 (5.5 feet) of the MGFD of MEC/MPPEH prior to placing the magazine. The magazine will be used to store donor explosives and all explosives stored in the magazine will be compatible per DESR 6055.09 edition 1 and DA Pamphlet 385-64. The magazine will have an externally mounted box to store the initiating explosives. The total NEW of 30 pounds will include the NEW of the initiating explosives.

b. The MSD for intentional detonation when conducting disposal operation is identified in Table 7-1. The Senior UXO Supervisor (SUXOS) and UXO Safety Officer (UXOSO) are authorized to jointly approve movement of “acceptable to move” items within the MRS for the purpose of activity efficiency and protection of personnel, property, and/or critical assets.

c. All recovered MEC and material presenting an explosive hazard (MPPEH) identified as material documented as an explosive hazard (MEDH) will be destroyed on the same day found. In the event this cannot occur due to weather or delay in explosive delivery, items will be guarded until disposal.

d. Inspection and Certification: All material potentially presenting an explosive hazard (MPPEH) procedures will be in accordance with DoDI 4140.62 and EM 385-1-97. All MPPEH will be assessed and its explosive safety status determined and documented prior to transfer within Department of Defense (DoD) or release from DoD control. Prior to release to the public, MPPEH will be documented by authorized and technically qualified personnel as Material Documented as Safe (MDAS) after 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosives safety perspective.

e. Collection points are those areas used to temporarily accumulate MEC which are determined acceptable to move by the SUXOS and UXOSO pending destruction at the end of the day using consolidated shots. MEC items at collection points must be laid out as shown in "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites, August 1998 (terminology update March 2000)." The maximum net explosive weight (NEW) at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the HFD for the area. Consolidating multiple MEC is anticipated for this project.

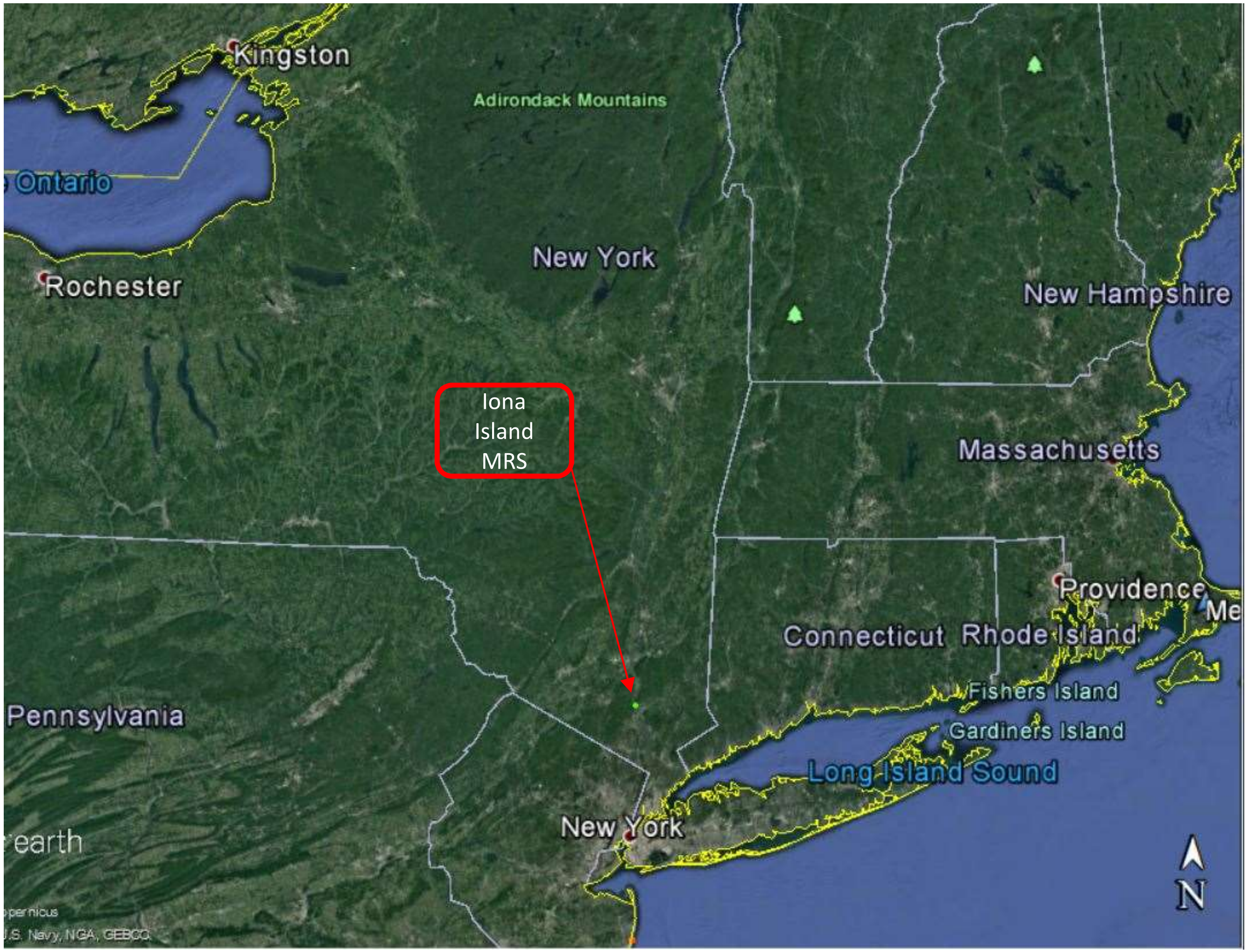
f. Consolidating multiple MEC may be anticipated for this project and will be performed in accordance with "Approval of Minimum Separation Distance to Non-Essential Personnel when using DDESB-Approved Consolidated Shot Method" (DDESB, 2015) and US Army Engineering and Support Center, Huntsville (CEHNC) publication "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites," dated March 2000, will be followed and a copy of this report will be available on site. The maximum NEW for a consolidated shot will be limited such that the K328 overpressure distance for the total NEW (including donor charges) does not exceed the MSD for intentional detonation.

g. Engineering Controls (EC): For intentional detonations, the UXO Team may use earth tamp as an engineering control in accordance with DDESB Buried Explosion Module, latest version, and DDESB TP 16.

Sandbag mitigation may be used as engineering controls to reduce the intentional detonation MSD. The sandbag controls will be used in accordance with 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; CEHNC-EMM 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

APPENDIX A
Figures



Iona Island Naval Depot
Iona Island, NY

EMDC, Baltimore District
US Army Corps of Engineers

Figure 1
Regional Map

Legend

MRS Location

Iona Island Naval Depot
Iona Island, NY

EMDC, Baltimore District
US Army Corps of Engineers

Figure 2
MRS Map
Iona Island

Legend

MRS Boundary

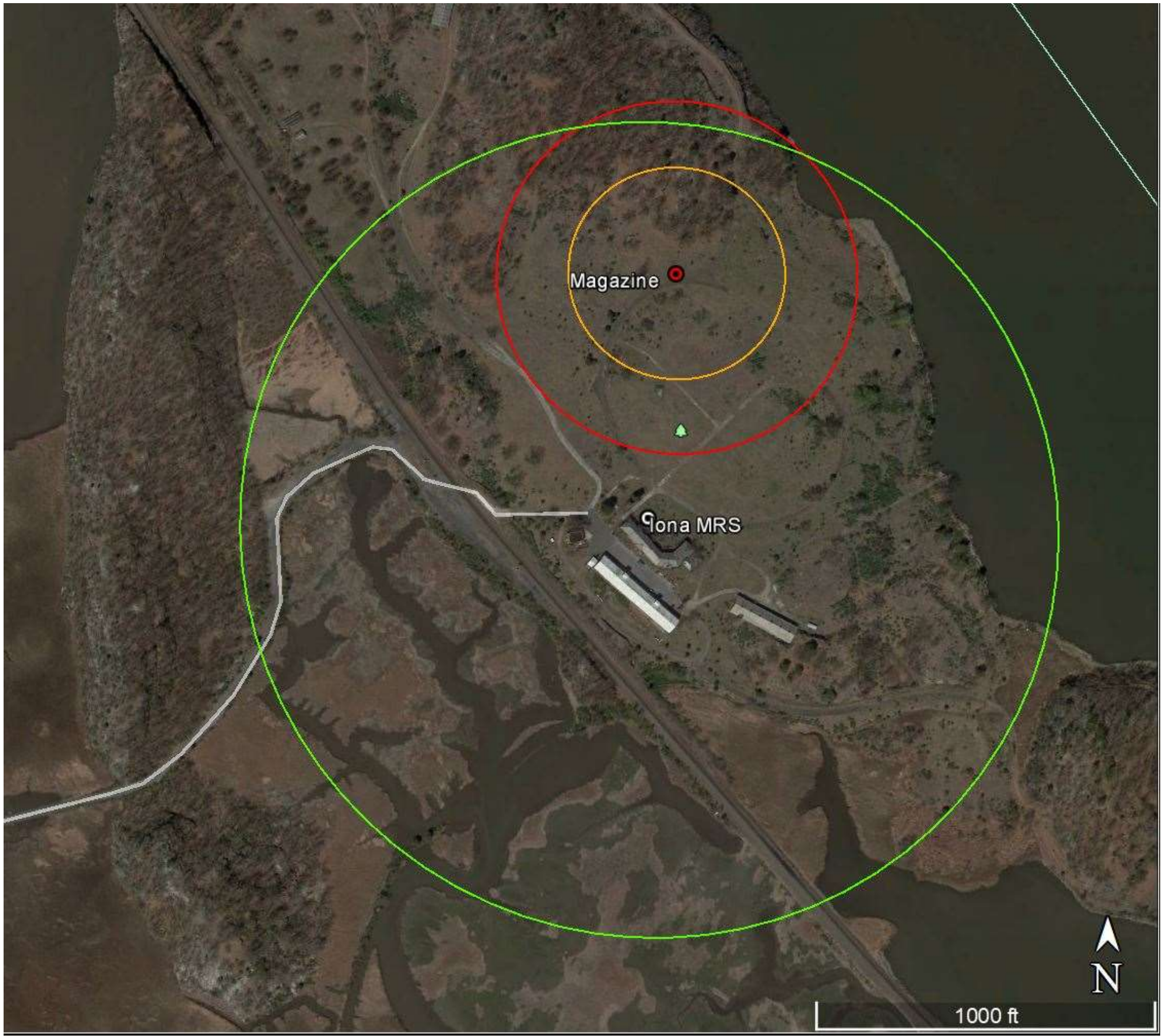
Iona Island Naval Depot
Iona Island, NY

EMDC, Baltimore District
US Army Corps of Engineers

Figure 3
Exclusion Area Map
Iona Island

Legend

- **MRS Boundary**
- **EC 200ft**
- **HFD 62ft**
- **MFD 521ft**



Iona Island Naval Depot
Iona Island, NY

EMDC, Baltimore District
US Army Corps of Engineers

Figure 4
Storage Magazine

Exclusion Area Map

Legend

MRS Boundary

PTRD 337 ft

IBD 561 ft

APPENDIX B
FRAGMENTATION DATA REVIEW FORMS

Fragmentation Data Review Form

Database Revision Date 5/3/2018

Category:	Grenades & Mines
Munition:	Mk II Grenade
Case Material:	Cast Iron, Grey, CL35
Fragmentation Method:	Pre-formed Fragmenting
Secondary Database Category:	Hand Grenade
Munition Case Classification:	Robust

DODIC:	G890
Date Record Created:	9/21/2004
Record Created By:	MMC
Last Date Record Updated:	5/3/2018
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	0.125
Diameter (in):	2.2600
Cylindrical Case Weight (lb):	0.24047
Maximum Fragment Weight (Intentional) (lb):	0.0129
Design Fragment Weight (95%) (Unintentional) (lb):	0.0043
Critical Fragment Velocity (fps):	578

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	62
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	521
MFD-V [Maximum Fragment Distance, Vertical] (ft):	397

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	0.125
3.5 psi, K18 Distance (ft):	9
2.3 psi; K24 Distance (ft):	12
1.2 psi, K40 Distance (ft):	20
0.0655 psi, K328 Distance (ft):	164

"NOTE: Values shown within this section only address overpressure hazards and do not account for applicable distance values for fragments and debris as required per DoD 6055.09-M."

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	0.125
Kinetic Energy 10^6 (lb-ft²/s²):	0.0021

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	12
Expected Max. Throw Distance (ft):	25
Minimum Separation Distance (ft):	25

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	10
Minimum Separation Distance (ft):	12.5

Water Mitigation

Minimum Separation Distance (ft):	200/200
Water Containment System:	5 gal carboys/ inflatable pool

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation (in)

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.15	0.79
Mild Steel:	0.07	0.05
Hard Steel:	0.06	0.04
Aluminum:	0.16	0.10
LEXAN:	1.61	1.23
Plexi-glass:	0.73	0.51
Bullet Resist Glass:	0.55	0.37

Item Notes

Fragment sizes, number of fragments and HFD came from test information. These numbers were used to calculate MFD-H using TP 16 Eq 4-34 & iterating using TRAJ to calculate the intial velocity. With this information, standard TP 16 methods were used to ca

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Appendix F

Field Standard Operating Procedures

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Appendix F

Field Standard Operating Procedures

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Appendix F1

ANJV Field SOPS

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STANDARD OPERATING PROCEDURE 1M

Assemble the MetalMapper System 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 MetalMapper sensor system and verifying that all 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.

The following individuals will be involved in the assembly and verification of the MetalMapper:

- Project Geophysicist
- QC Geophysicist
- Field Team Leader
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Geometrics MetalMapper sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and Inertial Measurement Unit (IMU) for orientation measurements
- transport vehicle (skid steer, tractor, extended reach forklift) used to move the MetalMapper during data collection
- a schedule 80 small Industry Standard Object (small ISO80) for operational testing
- digital camera or cell phone. (Note, personnel should not have cell phones when operating the MetalMapper)

3. Procedures and Guidelines

The Geometrics MetalMapper is an advanced electromagnetic induction sensor designed for the detection and classification of buried metal objects. The sensor consists of three orthogonal 1-m x 1-m transmit coils for target illumination and seven, three-axis receive cubes. It measures the decay curve up to 8-ms after the transmitters are turned off for each of the 21 receive channels. The orientation of the three transmit coils is shown in Figure 1.

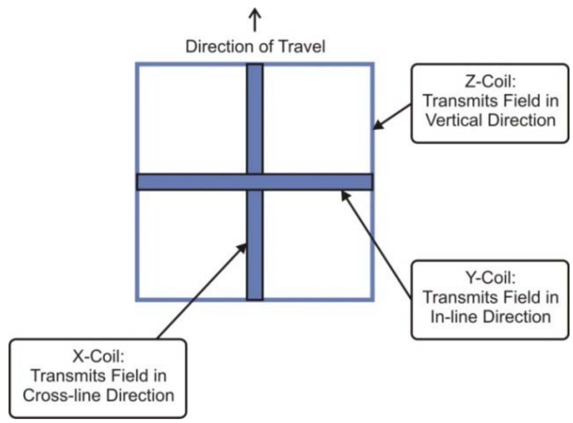

Figure 1. Orientation of the three MetalMapper transmit coils

Positioning of the MetalMapper is accomplished using an RTK GPS or RTS. The MetalMapper orientation is measured using a six-degree-of-freedom inertial measurement unit (IMU). For proper functioning it is important to verify that the IMU has been mounted to the MetalMapper in the correct orientation.

3.1. Assemble the MetalMapper

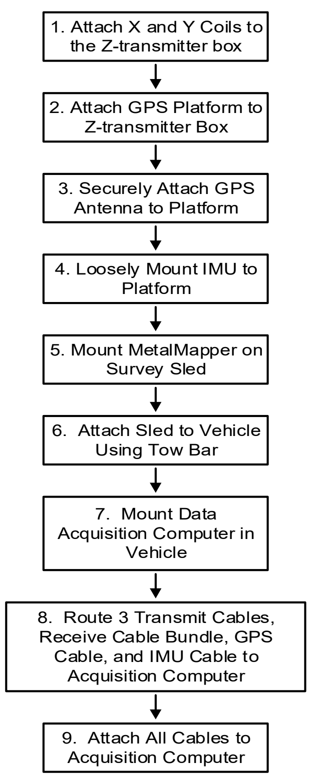

Figure 2 Overview of the MetalMapper system assembly

All assembly operations are described in the MetalMapper manual as published by Geometrics (see http://www.geometrics.com/files/metalmapper_manual_beta1.pdf) and the detailed instructions contained there should be followed precisely. Figure 2 shows a schematic overview of the assembly steps which are briefly described below:

1. Using the bolts and brackets provided, attach the X transmitter coil then the Y transmitter coil to the Z-transmitter box.
2. Attach the GPS platform legs to the Z-transmitter box and then the GPS platform to the legs.
3. Securely attach the GPS antenna or RTS prism to the platform.
4. Loosely attach the IMU to the platform. The attachment will be secured after correct IMU orientation is verified.
5. Mount the MetalMapper on the survey sled that will be used.
6. Mount one end of the attachment bar to the survey sled and the other end to the vehicle using the hitch mount provided.
7. Mount the data acquisition computer in the vehicle so that it can be easily accessed by the operator. Mount the display screen where it can be easily seen by the operator during normal vehicle operations. Do not obscure the operator's view of the sensor sled with the computer or screen.
8. Route all cables (three transmit cables, the receive cable bundle, and the cables for the GPS/RTS and IMU) along the attachment bar to the acquisition computer. Secure the cables to the bar in several places.
9. Attach all cables to the marked connectors in the acquisition computer.

3.2. Verify Assembly

In order for the standard data analysis routines to successfully handle MetalMapper data, you must verify that the transmit coils have been assembled in the correct orientation and the IMU has been installed correctly.

3.2.1. Orientation of the Transmit Coils

The correct orientation of the transmit coils and their polarities are shown in Figure 3. Visually verify that the assembled sensor matches this diagram.

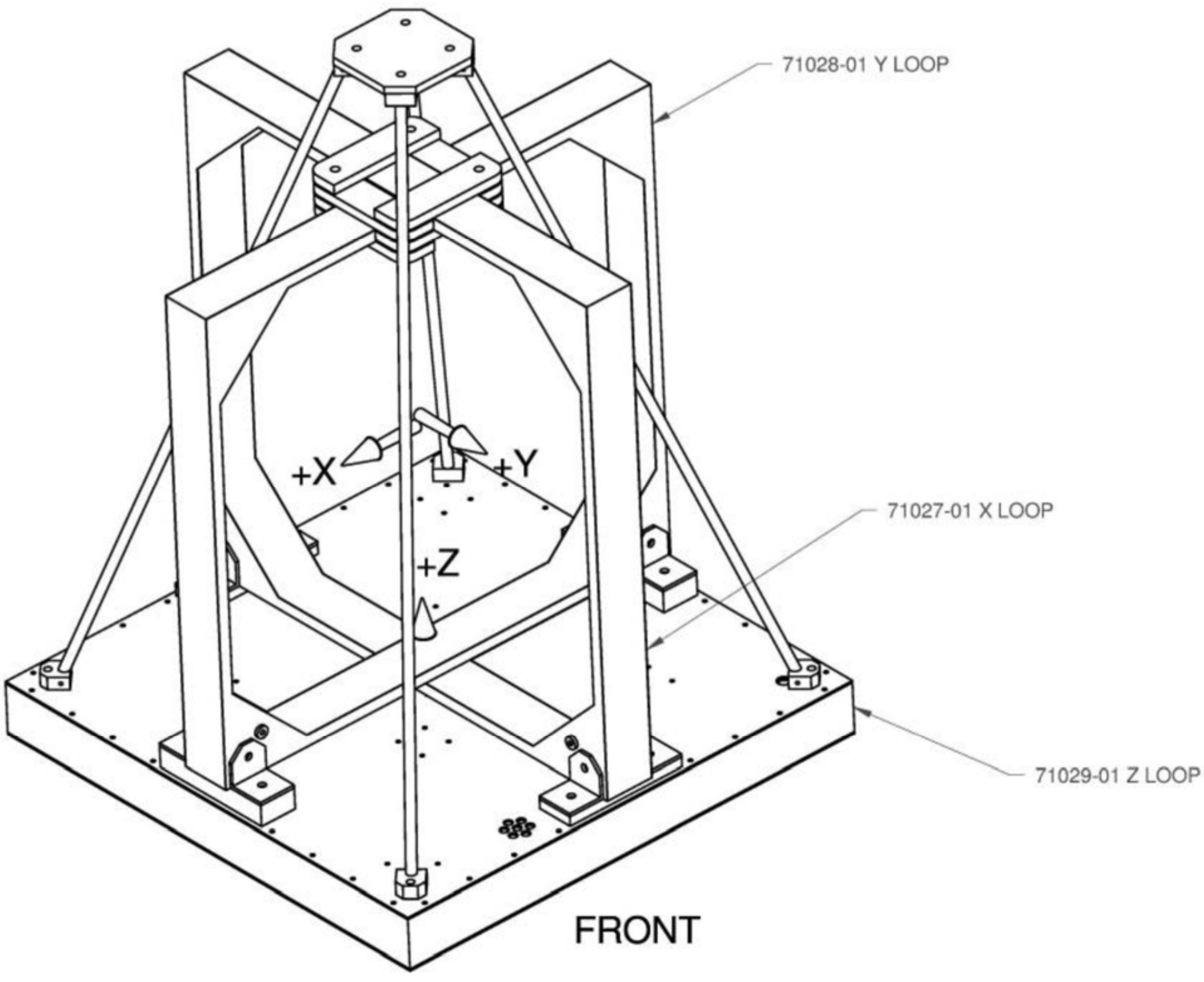

Figure 3. Correct orientations and polarities of the three MetalMapper transmit coils

3.2.2. Orientation of the IMU

The procedure to verify the correct orientation of the IMU is shown in Figure 4 and instructions for this test follow:

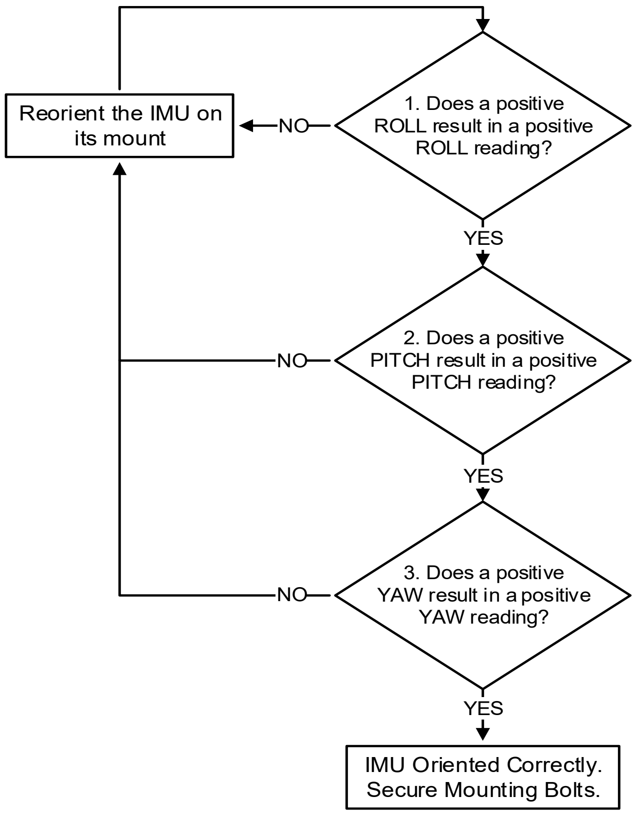

Figure 4. Procedure for verifying IMU Orientation

1. Facing the same direction as the front of the sensor, rotate the IMU around the along-track axis to produce a positive ROLL as shown in Figure 5. Verify that the data acquisition system records a positive ROLL. If it does not, reorient the IMU on its mount and test again.

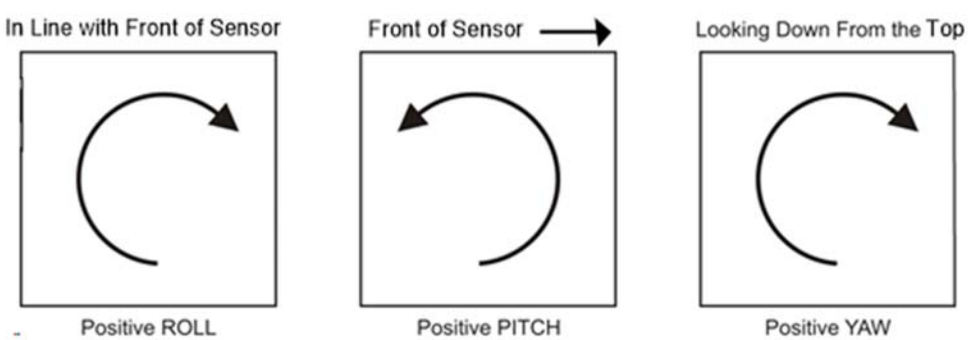

Figure 5. Positive ROLL, PITCH, and YAW rotations of the IMU

2. Standing on the side of the sensor with the front of the sensor to your right, rotate the IMU around the cross-track axis to produce a positive PITCH as shown in Figure 5. Verify that the data acquisition system records a positive PITCH. If it does not, reorient the IMU on its mount and return to step 1.
3. Looking down on the sensor from above, rotate the IMU around the vertical axis to produce a positive YAW as shown in Figure 5. Verify that the data acquisition system records a positive YAW. If it does not, reorient the IMU on its mount and return to step 1.

3.2.3. Operation of the GPS/RTS

Turn on the GPS or RTS receiver, allow it time to lock onto a position, and verify that GPS or RTS readings are being received at the data acquisition computer.

3.2.4. MetalMapper Function Test

Dig, or find, a small depression in the ground in a clear area as shown on the left side of Figure 6. Place a small ISO80 in the depression oriented horizontally. Center the MetalMapper over the depression so that the ISO is under measurement position 1.

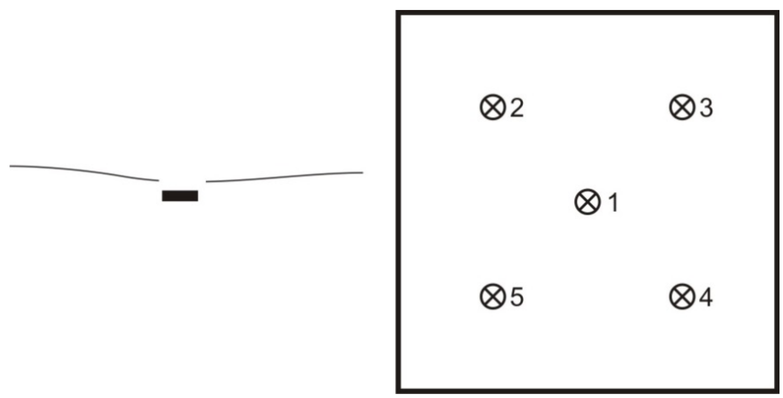

Figure 6. Small ISO80 placed horizontally in a shallow depression (left) and the five measurement locations under the MetalMapper (right)

Collect a cued measurement with the MetalMapper. Verify that the transmit current is within the expected range. Position the MetalMapper so the ISO is under measurement positions 2 through 5 collecting cued data in each position. Invert each of the five data sets and verify that the resulting polarizability decays match the library values for a small ISO80 with a match metric of 0.95 or greater.

3.2.5. Photograph the Sensor

Using a cell phone or other pocket camera, photograph the installed sensor. Verify that the photograph(s) depict the orientation of the MetalMapper relative to the vehicle and shows the locations of the GPS/RTS and IMU sensors.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the MetalMapper manual as published by Geometrics.

4.2. Output Data

The five test measurements over the ISO80 described in Section 3.2.4 will be saved in the project database along with the inversion results and library match metric for each of the measurements. Also, the QC checklist in Attachment 1 of this SOP will be completed, signed, and filed with the assembly photograph as proof of correct assembly.

5. Quality Control

As this definable feature of work is accomplished only during the preparatory phase, only preparatory QC checks will be performed. QC consists of performing the inspections on the Preparatory Phase Quality Control Checklist that is included as Attachment 1 to this SOP. This checklist will be completed by the Field or Project Geophysicist and will be observed by the QC geophysicist who will document the implementation of this SOP in the Geophysics Daily QC Report.

The measurement quality objectives (MQOs) for this task are presented in Worksheet #22 of the project-specific QAPP. The MetalMapper will not be tested on the Instrument Verification Strip (IVS) (SOP 2) until the MQOs are documented as being met as described below.

6. Reporting

Achievement of the Sensor Assembly MQOs (see the MQOs in Worksheet #22) will be documented by the Field or Project Geophysicist by completion of the Preparatory QC Checklist in Attachment 1 to this SOP and will be verified by the QC Geophysicist in the Geophysics Daily QC Report.

The delivered data package for the assembled and tested MetalMapper will include:

- a brief description of the assembly and test process along with the photograph(s) taken in Section 3.3 will be included in the IVS letter report.
- the completed Preparatory QC Checklist signed by the Project, Field Geophysicists verifying the assembly and orientation tests described above.
- the inversion results from the five measurements over the ISO80 overlain over the library polarizabilities for the small ISO80.
- the verification in the Geophysics Daily QC Report.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

1/5/18 Added ANJV logo

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STANDARD OPERATING PROCEDURE 1 MM2
Assemble the MetalMapper 2x2 System 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 MetalMapper 2x2 sensor system for dynamic collection and verifying that all components are correctly assembled, operating normally, and capable of acquiring quality data.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the MetalMapper 2x2:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 and 8.

The following is a list of required equipment and materials:

- MetalMapper 2x2 sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and Inertial Measurement Unit (IMU) for orientation measurements
- a serialized Industry Standard Object (ISO) from Geometrics for sensor function testing
- a digital camera or cell phone. (Note, personnel should not have cell phones when operating the MetalMapper)

3. Procedures and Guidelines

The MetalMapper 2x2 is an advanced electromagnetic induction sensor designed for the detection and classification of buried metal objects. The sensor consists of four sensor elements arranged on 40-centimeter (cm) centers in a 2x2 array. Each sensor element consists of a 35-cm square transmit coil for target illumination with a 10-cm three-axis receive cube centered in the transmit coil. The transmitters are energized in sequence and the decay curve is recorded up to 25 milliseconds after the transmitters are turned off for each of the 12 (4 cubes with 3 axes each) receive channels. A schematic of the sensor coil configuration is shown on Figure 1.

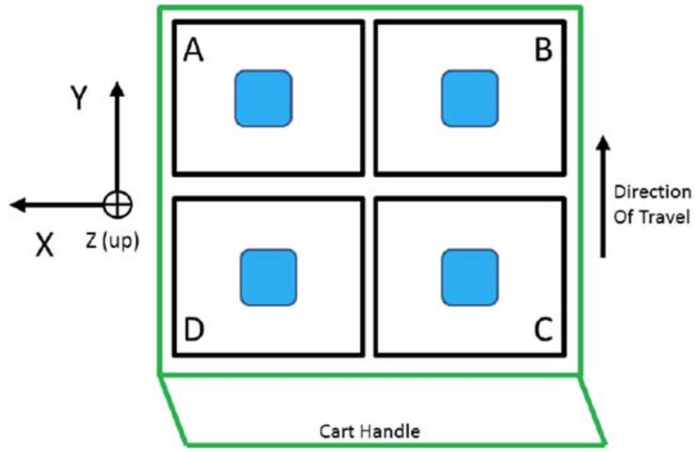

Figure 1. Orientation of the Four MetalMapper 2x2 Sensor Elements (top view)

Positioning of the MetalMapper 2x2 is accomplished using an RTK GPS or RTS. The MetalMapper 2x2 orientation is measured using a six-degree-of-freedom IMU. For proper functioning, it is important to verify that the IMU has been mounted to the MetalMapper 2x2 in the correct orientation.

3.1. Assemble the MetalMapper 2x2

All assembly operations are described in the MetalMapper 2x2 unpacking instructions and operating manual (MetalMapper 2x2 Manual- 1.01.pdf) available from Geometrics and the detailed instructions contained there should be followed precisely. The assembly steps include:

1. Remove the sensor assembly from the packing crate.
2. Attach handle, wheels, or sled as appropriate.
3. Securely attach the GPS antenna or RTS prism to the top of the mounting platform. If GPS/RTS is not being used, move to Step 4.
4. Set the IMU onto its position below the GPS antenna/RTS prism. The attachment will be secured after correct IMU orientation is verified.
5. Connect the sensor cable bundle to the sensor. This includes the sensor Tx and Rx cables and the cables to the GPS/RTS and IMU.
6. Attach the Tx, Rx, GPS/IMU, Ethernet cable, and battery power cable to the electronics box.

3.2. Turn On and Initialize the Data Acquisition Computers

Following the instructions in Section 4 of the MetalMapper 2x2 manual, start the data acquisition system. The last step in Section 4 involves observing the IMU output. Leave the system in this state for the next operation.

3.3. Verify IMU Orientation and Values

The procedure to verify the correct orientation of the IMU follows:

1. Facing the direction of travel, rotate the IMU around the along-track axis to produce a positive ROLL as shown in Figure 2. Verify that the data acquisition system records a positive ROLL, Figure 3. If it does not, reorient the IMU on its mount and test again.

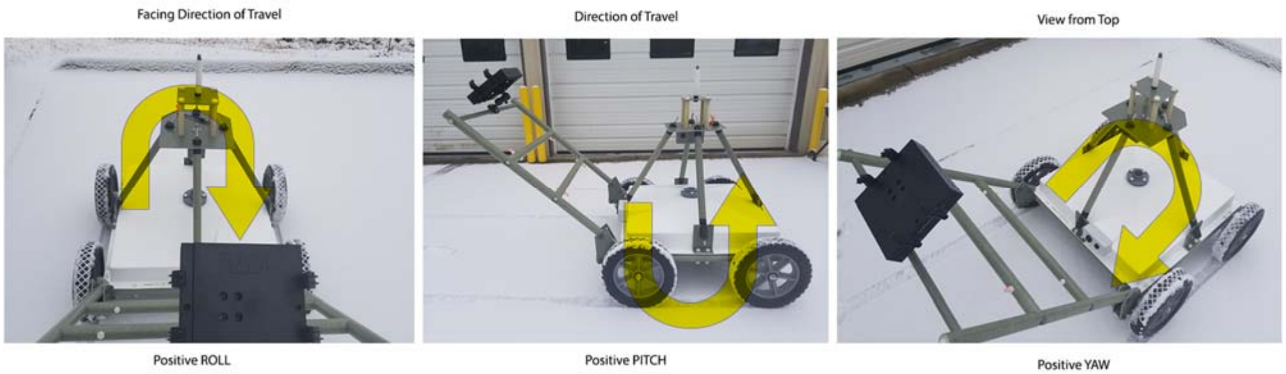

Figure 2. Positive ROLL, PITCH, and YAW Rotations of the IMU

Figure 3. Electronics Box Screen Showing Orientation Inputs (YPR)

2. Standing on the side of the sensor with the direction of travel to your right, rotate the IMU around the cross-track axis to produce a positive PITCH as shown in Figure 2. Verify that the data acquisition system records a positive PITCH. If it does not, reorient the IMU on its mount and return to step 1.
3. Looking down on the sensor from above, rotate the IMU around the vertical axis to produce a positive YAW as shown in Figure 2. Verify that the data acquisition system records a positive YAW. If it does not, reorient the IMU on its mount and return to step 1.
4. Use a cell phone applet, such as SPIRIT Level, to verify that the roll, pitch, and yaw readings are not materially biased. To verify, start Spirit Level (or similar app) on the phone, place the phone on the sensor frame such that it is on the same plane as the IMU sensor, and verify that the readings using the cell phone application agree with the IMU values on the data logger to within 2 degrees (Figure 4). If the difference is greater than 2 degrees perform the “Capture Gyro Bias” procedure and return to step 1. If the difference is greater than 2 degrees after performing the “Capture Gyro Bias” procedure, document the measured bias in the field notes. If the difference is less than 2 degrees, the test is deemed successful and is documented in the field notes.

Figure 4. Cell phone running SPIRIT Level, an independent measurement of sensor roll and pitch, to guard against materially significant bias in the IMU sensor.

3.4. Photograph the Sensor

Using a cell phone or other camera, photograph the installed sensor. Verify that the photograph(s) shows the locations and orientations of the GPS/RTS and IMU sensors.

3.5. Set up the Data Acquisition Parameters

In preparation for the sensor function test, use the [Project Settings] tab in the acquisition software to set the correct data acquisition parameters for the dynamic survey. The standard parameters are listed in Table 1.

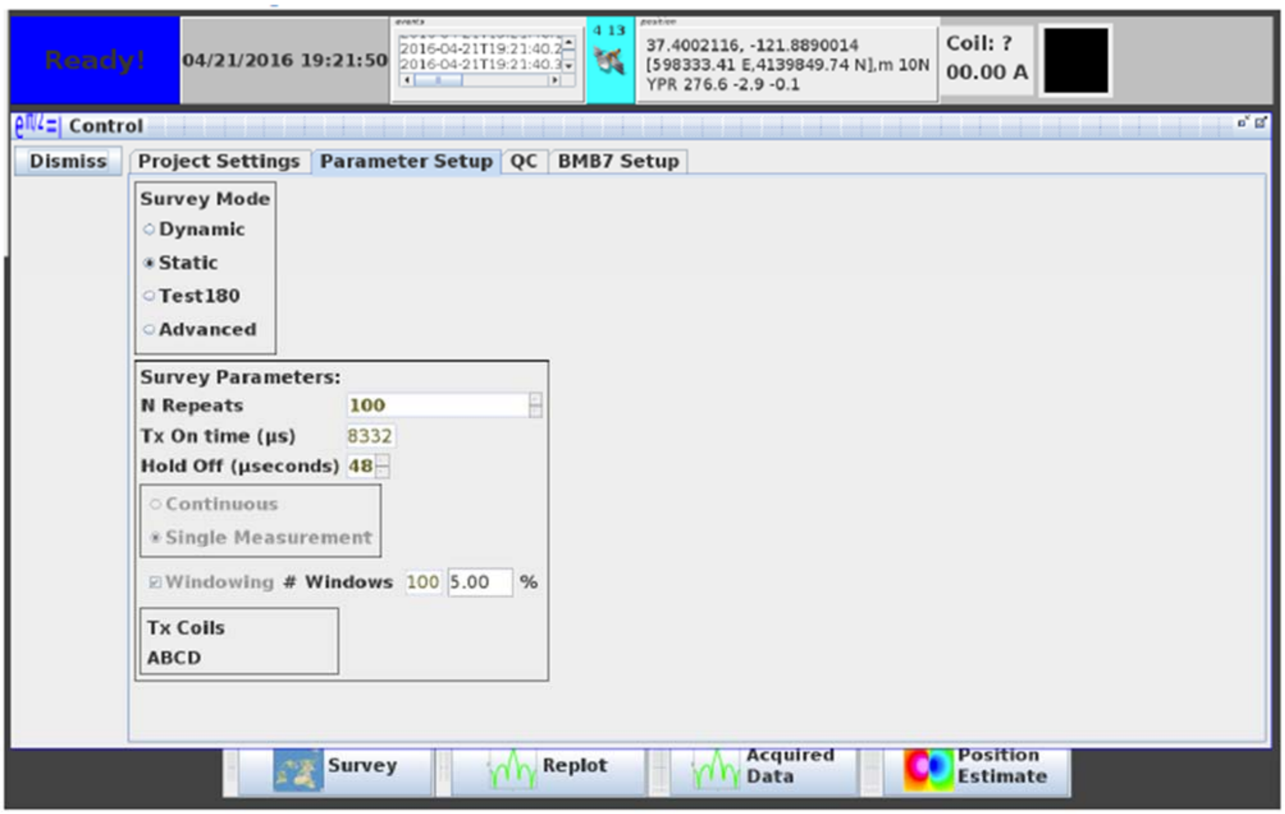

Figure 5. Standard Acquisition Parameters for Static Surveys

Table 1. Standard Data Acquisition Parameters

Parameter	Cued Survey	Dynamic Survey
Acq Mode	Decimated	Decimated
Gate Width	5%	20%
Stacks	1	1
Repeats	100	3
Stack Period	0.9	0.033

3.6. Perform a Sensor Function Test

Select the reference SFT or DFT response for the combination of hardware and data acquisition parameters you are using on the [QC] tab.

1. Position the sensor in a spot known to be clear of buried metal. Often the clear position in the Instrument Verification Strip (IVS) will be the best choice. Collect a background measurement by selecting Background from the dropdown menu on the main survey screen of the data acquisition software.
2. Without moving the sensor, mount the serialized ISO in the hole on the top of the sensor housing (Figure 6).
3. Select Sensor Function from the dropdown menu and collect sensor function data. If the results agree with the reference values, a position estimate with delta values is displayed; these values must be less than 2.0 to pass. If they do not agree, a warning dialog with a summary of the incorrect results.
4. Transfer the background and sensor function data files to the Data Processor/QC Geophysicist for archiving.
5. The Data Processor/QC Geophysicist will verify the sensor function test using the purpose-built tool “Sensor Function Test” in UX-Analyze.

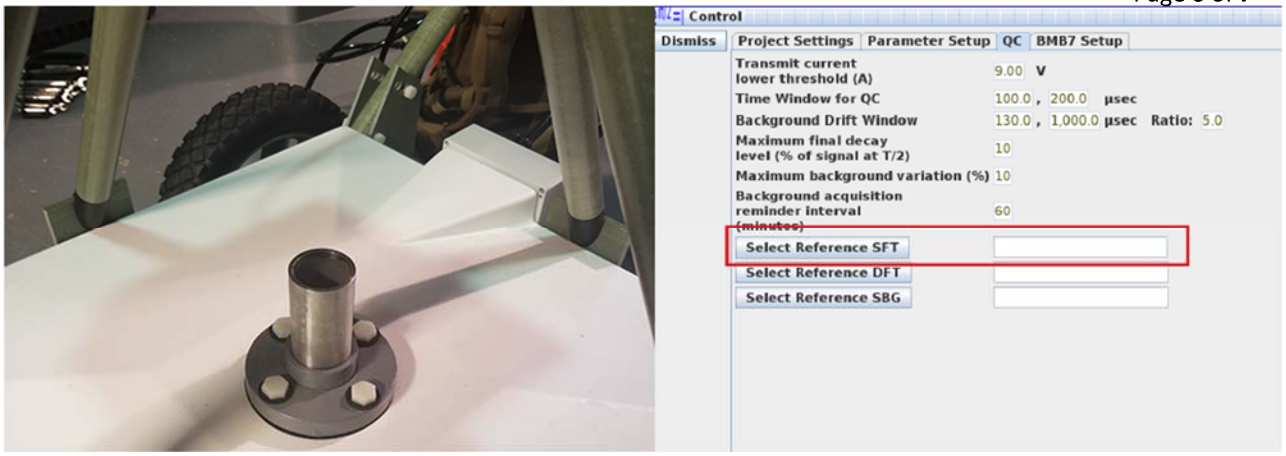

Figure 6, left panel – photograph of the standardized test object on the MetalMapper sensor. Right panel – screen snapshot of the data logger

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the assembly and operation instructions for the MetalMapper 2x2 contained in the operating manual from Geometrics.

4.2. Output Data

The sensor function test described in Section 3.6 will be saved in the project database. Also, the QC checklist in Attachment 1 of this SOP will be completed, signed, and filed with the assembly photograph(s) as proof of correct assembly.

5. Quality Control

As this definable feature of work is accomplished only during the preparatory phase, only preparatory QC checks will be performed on this activity. QC consists of performing the inspections on the Preparatory Phase Quality Control Checklist that is included as Attachment 1 to this SOP. This checklist will be completed by the Field or Project Geophysicist and will be reviewed by the QC Geophysicist who will document the implementation of this SOP.

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly instructions have been followed. The MetalMapper 2x2 will not be tested on the IVS (see SOP 2) until this has been documented as described below.

6. Reporting

Achievement of the Sensor Assembly MQO will be documented by the Field or Project Geophysicist by completion of the Preparatory QC Checklist (ANJV QC application) and will be verified by the QC Geophysicist.

The delivered data package for the assembled and tested MetalMapper 2x2 will be included in a section of the IVS Letter Report and will include:

- a brief description of the assembly and test process along with the photograph(s) required by Section 3.4 of this SOP.
- the completed Preparatory QC Checklist signed by the Project or Field Geophysicists and checked by the QC Geophysicist verifying the assembly and orientation tests described above.
- the Sensor Function Test result.

7. Revision History

1-19-18 Initial release.

10-23-18 Removed reference to specific title of IVS report

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AcornSI and NAEVA JV
ADVANCED GEOPHYSICAL CLASSIFICATION

STANDARD OPERATING PROCEDURE 1MPV
Assemble the MPV System 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 Man Portable Vector (MPV) sensor system for data collection and verifying that all 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.

The following individuals will be involved in the assembly and verification of the MPV:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- MPV sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and Attitude and Heading Reference System (AHRS) for orientation measurements
- a standard test object (Industry Standard Object (ISO), sphere, etc.) for sensor function testing
- a digital camera or cell phone. (Note, personnel should not have cell phones when operating the MPV)

3. Procedures and Guidelines

The MPV is a handheld advanced electromagnetic induction sensor designed for the detection and classification of buried metal objects. The sensor consists of circular transmitter coil and five receiver cubes distributed in a cross pattern within the 50cm diameter MPV sensor head. Each 8-cm receive cube is comprised of a set of three-axis receive coils. For cued interrogation, the sensor head is augmented with a pair of orthogonal horizontal axis transmitter loops. These are supplied as detachable rectangular shaped units that can be placed on top of the main sensor head. The transmitters are energized in sequence and the decay curve is recorded up to 25 milliseconds after the transmitters are turned off for each of the 15 (5 cubes with 3 axes each) receive channels. Photos of the MPV sensor in dynamic and cued configurations are shown in Figures 1 and 2, respectively.

Figure 1. Photo of MPV sensor with attached boom for dynamic data collection.

Figure 2. Top view of the MPV sensor with pair of orthogonal horizontal axis transmitter coils for cued data collection.

Positioning of the MPV is accomplished using an RTK GPS or RTS. The MPV orientation is measured using the AHRS sensor. For proper functioning, it is important to verify that the AHRS has been mounted to the MPV in the correct orientation.

3.1. Assemble the MPV

The main assembly is the standard configuration for dynamic data collection. It consists of all the equipment described in the previous section except for the horizontal axis transmitter coils which are only used for cued data collection. The assembly steps include:

1. Attach the boom to the sensor head by inserting the bottom tube into the MPV head mounting bracket and gently pulling the top cube to extend the inner cable. Marks on the tubes indicate the relative location of the bracket and tubes. The tubes may need to be rotated to line up markers. Gently tighten bolts with an adjustable wrench to secure the tubes.
2. Mount GPS antenna or RTS prism and mast on the top end of the boom. Attach GPS antenna or RTS prism to cable that comes out of the serial box (Figure 1) and power up. If GPS/RTS is not being used skip this step and move to Step 3.
3. Verify that the AHRS unit is present, secure and connected.
4. Mount DAQ on backpack. Attach battery next to DAQ and secure straps.
5. Connect the receiver and transmitter cables to the DAQ, making sure to match the labels on the cables to the DAQ. Begin with the small receiver connectors and gently align the red dot markers. Finally, connect all the transmitter connectors using the labels as a guide.
6. Connect the DAQ power cable to the battery. This connection turns on and off the DAQ.
7. Field computer options:
   a. If using the ToughPad tablet: power up the tablet, connect the USB cable from the NI cDAQ to the serial box at the upper end of the MPV boom, near the GPS, then connect tablet with USB cable from serial box.
   b. If using the Stealth: if using a wired display, keep Stealth disconnected to battery until you connect display to Stealth and to battery, then only connect Stealth to its battery. This will automatically power up the Stealth. Connect the USB cable from NI cDAQ to the Stealth and connect the cable out of USB serial box to Stealth.
8. Attach the bundle of cables that connect the MPV head to the DAQ to the frame of the backpack with a bungee to provide a strain relief mechanism.

3.2. Cued Interrogation Assembly

A set of two horizontal axis transmitter coils is used for cued interrogation. The two coils are separated for transport and storage. The coils are marked X and Y with an arrow that indicates their positive direction.

1. Slide the X-coil inside the Y-coil following guiding blocks. Start by placing the Y-coil on the ground, standing on its side, such that the Y-arrow is on top and pointing to the North. Similarly have the X-coil stand on its side and pointing to the East. Place the X-coil to the South of the Y-coil, then slide the X-coil inside the Y-coil (Figure 2).

2. Push the X-coil until it is exactly halfway in the Y-coil, as indicated by guiding blocks in the center of the X-coil. Attach small latch with plastic screws to secure the mount.
3. The coils are to be mounted in orthogonal directions such that if the MPV is pointing to the North, the X- coil arrow is directed to the North-East and the Y-coil arrow to the North-West, as shown in Figure 2. The set of transmitters is placed on top of the MPV sensor head and rests on guiding blocks that constrain its position. The X and Y transmitters are powered through a cable that attaches near the top of the MPV boom.

3.3. Verify Assembly

3.3.1. Alignment of Handle and AHRS

The sensor handle is a tube that may rotate. The AHRS unit should be oriented with the same roll and pitch as the sensor head, such that the GPS mast is vertical when the sensor head is horizontal. The assembly should be in this configuration if all markers on the tubes are aligned. This task first requires that data from the AHRS unit be readable in EM3D.

1. Verify that the DAQ is being powered and the USB cable is connected to the computer.
2. Start the data acquisition program EM3D (Figure 3), push the "S" button to bring the settings menu (Figure 4), then push the "O" button to bring the AHRS menu (Figure 5).
3. Start the AHRS unit, verify that readable angles are being displayed; otherwise modify the instrument name, COM port and baud rate (default is 115200 baud) until numbers are being displayed.
4. Place a bubble level, digital inclinometer or mobile phone applet (such as SPIRIT level) on the MPV head and adjust the MPV to a horizontal position.
5. Monitor the roll and pitch in EM3D on the tablet.
6. Compare the AHRS reading. The assembly is correct if the magnitude of the roll and pitch are less than one degree. Otherwise, loosen the bolt that secures the top and bottom tubes and rotate the handle until the roll and pitch meet the above criterion, then gently tighten the bolt.

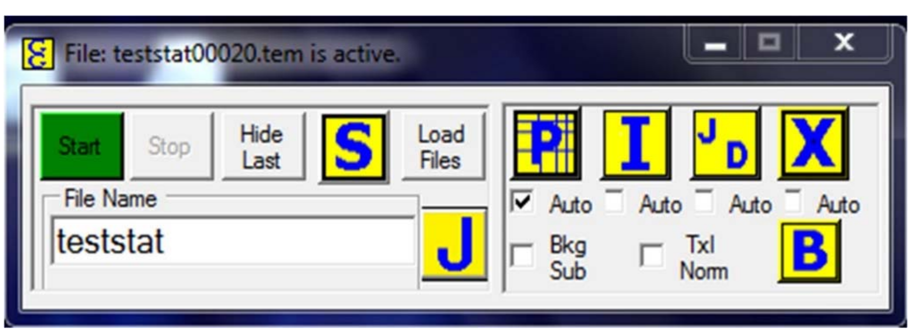

Figure 3. EM3D main acquisition menu

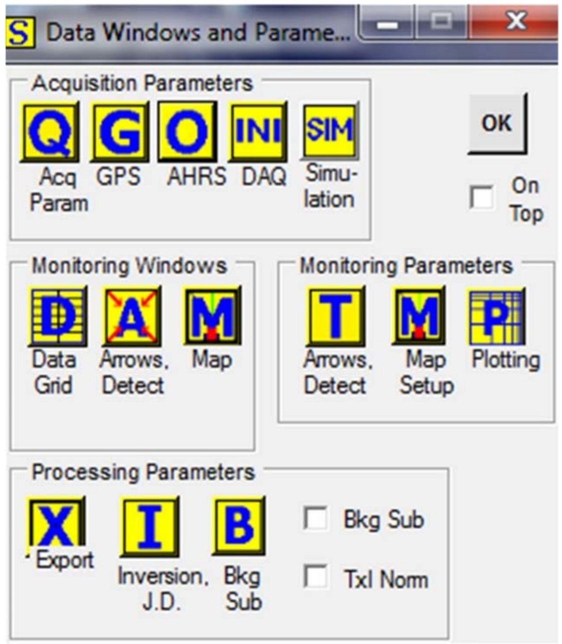

Figure 4. EM3D settings menu

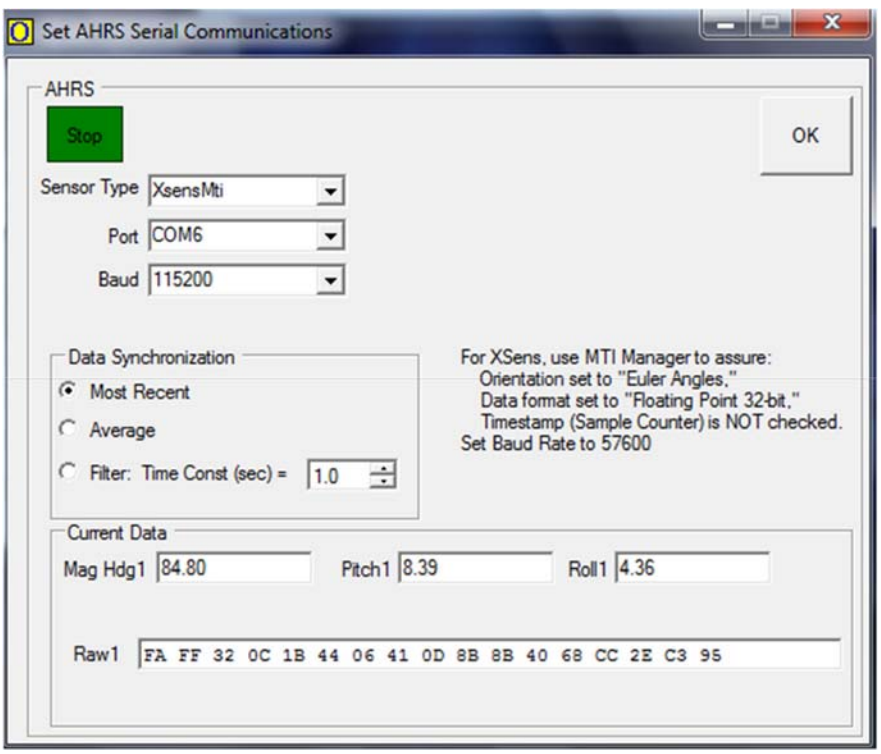

Figure 5. AHRS unit parameters window

3.3.2. GPS Antenna / RTS Prism Position

Immediately following the above procedure, with the sensor head in horizontal position, measure the position of the GPS/RTS relative to the sensor head:

1. Measure the height above ground of the center of the GPS antenna or RTS prism. The vertical offset is that height minus 0.04 m (half the sensor head thickness). This measurement is denoted DZ. Mark on the ground the point directly under the GPS antenna.
2. Measure the distance from that point on the ground to the center of the MPV sensor head and take note of DY.

3.3.3. System Setting

EM3D relies on a configuration file that lists some of the key components to be used for acquisition. This INI file should be reviewed to verify that the parameters match the sensor configuration that is being used:

1. Open the INI file editor (Figure 6) by clicking the button "INI" on Figure 4.
2. The field "GPSAntennaCoordinate" should be edited to have the values “0, -DY, DZ” (with commas separating values) that were recorded in 3.3.2.
3. Enter the magnetic declination to the local value, with the convention that the magnetic declination relative to the North Pole is positive in the East direction. For instance, the magnetic declination is generally negative on the East Coast of North America and positive on the West Coast. The local declination should be calculated before heading to the site so that all the collected data has consistent positioning.
4. Verify the number of receiver cubes and modules. There should be 4 listed modules if 5 cubes are being used, and 3 modules if only 4 cubes are used.
5. After verification push the button "Save as current params".

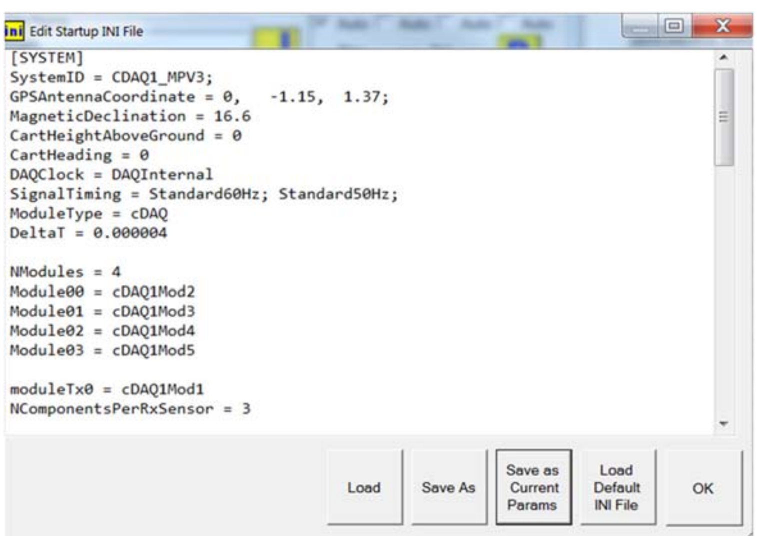

Figure 6. Typical INI parameters

3.4. Operation Setup

3.4.1. GPS / RTS setup

1. In the settings window of EM3D (Figure 4), open the GPS menu (Figure 7) and push the “Start GPS” button to start the GPS/RTS. If needed, edit the receiver string and change the type to "Gpgga", edit the COM port and baud rate (57600 baud default) and make sure that GPS/RTS data are steaming in, are readable in the raw data field, and that a Fix Quality of 4 for GPS data can be achieved in open sky condition. If that quality cannot be achieved, verify that the GPS is correctly set up to receive corrections.
2. Test that the GPS coordinates are properly getting imported by moving the MPV forward, then backward, while monitoring its position on the EM3D map (Figure 8, obtained through the menu of Figure 4). If there is any delay or any other unexpected behavior, verify the settings, toggle the receiver string menu between "Gpgga" and another setting, then test again.

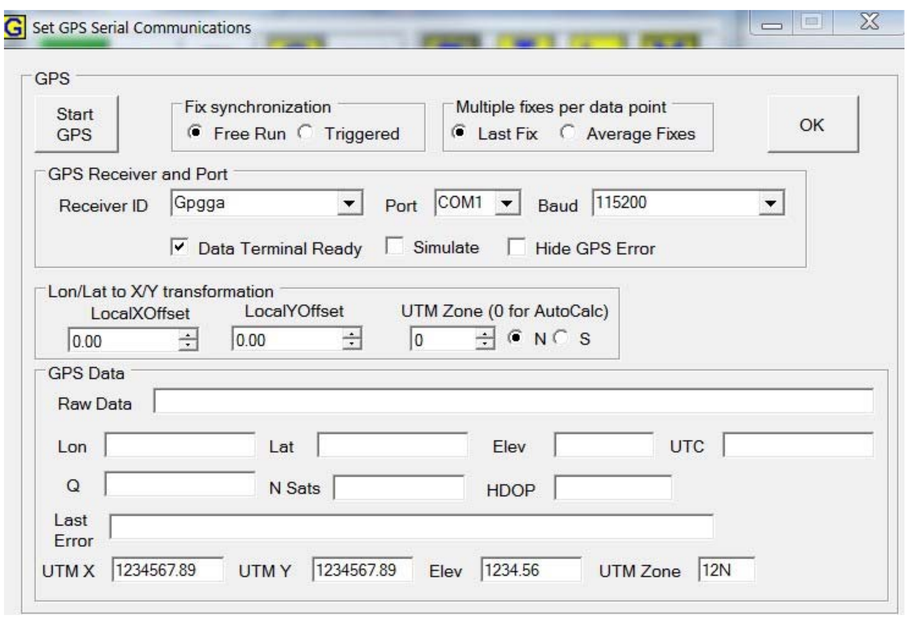

Figure 7 GPS parameters

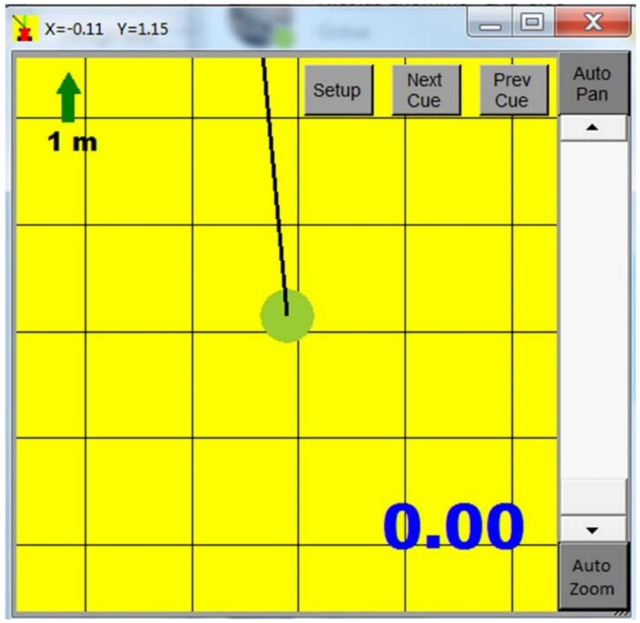

Figure 8 Map View

3.4.2. AHRS

The task is to establish the communication with the AHRS, adjust its site-specific parameters if needed and verify that the data can be processed by the data acquisition software EM3D.

1. The AHRS performs best when its geo-location is known, and the Earth's local magnetic field can be predicted. The MicroStrain AHRS-specific MIP software needs to be called to adjust that information when moving to a significantly different geographic location. The MIP Monitor is called from the computer. If the AHRS unit is connected it should appear in the list of devices. Click on it, set it to stream, select the settings menu, adjust the geographic location for the EF filters, save as default settings and exit MIP.
2. Open the AHRS parameter display (Figure 5), select the appropriate AHRS type and start the AHRS unit. Adjust display parameters if needed until readable angles can be displayed. The magnetic declination should not be set to auto-calculation and should be set to 0; the declination is already accounted for through the MIP software.
3. Perform a series of orientation tests to verify that the AHRS is properly mounted and the data are correctly interpreted:
    a. Roll test: Start with the MPV sensor head resting horizontally on the ground. Holding the MPV by the boom, lift the left side of the MPV head off the ground and read the roll angle on the display: the roll should be positive.
    b. Pitch test: Start with the MPV sensor head resting horizontally on the ground. Lift the front of the MPV head: the pitch reading should be positive.
    c. Yaw test: Start with the MPV sensor head resting horizontally on the ground. Moving the MPV sensor head clockwise: the yaw reading should be positive.

3.4.3. Data Acquisition

The first task is to open the acquisition window (Figure 9) and verify the EMI parameters are correct for the job and edit, if necessary, the parameters for survey type, transmitters, time decay, time total (data block), gate width and hold off. The DAQ should always record in "Decimated" Mode. A folder name should be set, and the naming method should use "IncrementedNumbers". The tick mark to "Check GPS on" should be applied. Standard settings are listed below in tables 1 and 2.

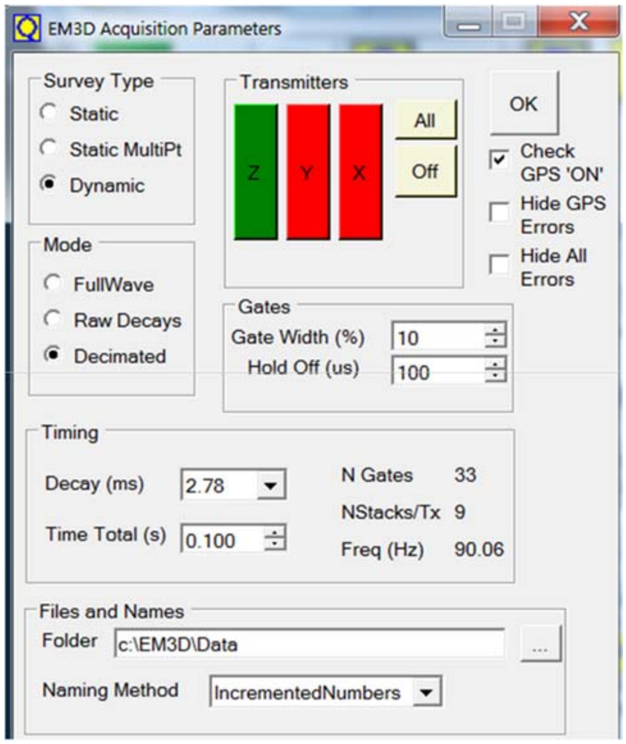

Figure 9. Acquisition Parameters Window

Table 1. Standard Cued Survey Acquisition Parameters

Survey type	Transmitters	Decay (ms)	Time Total (s)	GateWid	GateHOff (µs)
Static	ZYX	25	20.1	10%	100

Table 2. Standard Dynamic Survey Acquisition Parameters

Survey type	Transmitters	Decay (ms)	Time Total (s)	GateWid	GateHOff (µs)
Dynamic	Z	2.78	0.1	10%	100

Verify that the EMI elements are working. Open the Plotting parameters window (push "P" in Figure 4), select to view all cubes and the transmitter current (Figure 10), then push the green Start button on the main EM3D menu and verify that there is current in the transmitter and signal in the receivers.

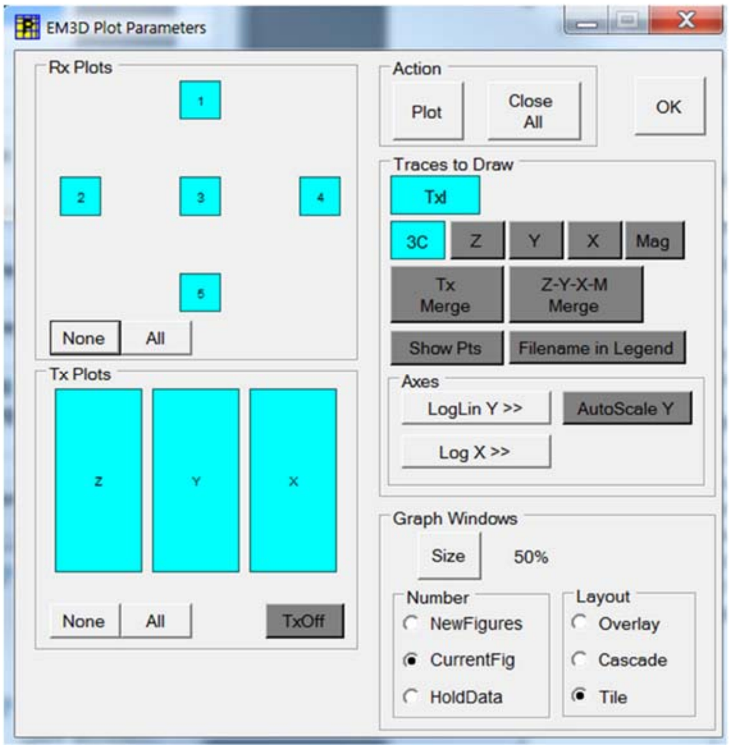

Figure 10. Plotting Parameters Window

3.5. Sensor Operation Tests

3.5.1. Spin Test

Accurate navigation with EM3D requires correct integration of the GPS/RTS and AHRS units and correct specification of the geometry. This aspect is critical for the MPV since the GPS antenna or RTS prism is more than 1 meter away from the sensor head and the AHRS information is used to translate the MPV sensor head location from the GPS or RTS position. This verifies that the predicted MPV sensor head location is not moving when rotated around a fixed location.

We first verify that the GPS and AHRS data are being imported. Open the data grid ("D" in Figure 4) and select the navigation tab ("Nav"). Verify that positions and orientations are updating when moving the MPV handle.

The Spin Test should be performed several times a day to verify proper operation of the GPS or RTS and AHRS. If the GPS or RTS and AHRS function properly (no bias in the AHRS data stream or that the GPS and AHRS are not drifting) and the sensor geometry is correctly defined in the sensor definition files, the center cube of the MPV should exhibit a limited range of motion when the MPV is rotated about the center of the head. The test data are to be recorded for validation. The test is set up by first selecting acquisition in dynamic mode, bringing the map view to a tight one-meter grid zoom level, and placing the sensor head on the ground on a flat surface where it should be easy to keep the sensor head centered on the same point during a 360-degree rotation in the horizontal plane (this can be facilitated by planting pegs in the ground or using a jig during the rotation). One operator walks a full circle around the center of the sensor head while holding the upper end of the boom, keeping clear of the GPS antenna or RTS prism, while the other operator monitors the position of the sensor head on the map display to verify that it is not moving by more than 0.2 m during the revolution.

If the sensor head appears to be moving away on the map display, try again at a slower pace, then verify that the GPS or RTS and AHRS are properly set up. Possible causes can be GPS, RTS or AHRS not streaming, GPS or RTS buffering (stop-start in EM3D, toggle receiver string), wrong GPS or RTS offset entry in INI file, wrong geographical coordinates in MIP causing a heading offset, buffering issue due to CPU overload (check CPU or buffer usage in EMI acquisition).

The data collected during the spin test will be re-examined off-site to verify that there was no significant drift and to apply any needed correction to the processing of the GPS or RTS, AHRS and EMI data.

3.5.2. Navigation Test

This test verifies that the GPS is reporting accurate positions and that EM3D can be relied upon for navigation. This test consists of placing the MPV sensor head at a known location and taking a cued measurement to keep a record of the location. There are two possible tests:

1. If the IVS has already been set up and seeded target locations are known: Load the IVS target locations in EM3D in the Map display (bare .CSV file listing just the easting, northing and an identification number, using separate lines for each target). Navigate with the MPV to an IVS target and verify that the sensor location (green dot) matches the target location (blue or red dot).
2. If the IVS is not setup, load up a .CSV file with the location of a control point (monument) and place the center of the MPV sensor head at the control point.

3.5.3. Sensor Function Test

The objective of the function test is to confirm that all transmitters and receivers are operating as expected. This is achieved by recording the instrument response to a known calibration item, and then comparing the data to a reference measurement. The reference measurement represents data acquired of the calibration item when the instrument was established to have been operating properly.

The MPV function tests consist of acquiring a static measurement with a Standard test item placed at an identical location with respect to the center of the array.

1. Place the sensor head horizontally on the ground and keep it stationary for the entire test.
2. Collect one background measurement. Select the file as default background using the "B" button as displayed in Figure 4.
3. Place the function test item in the holder on the marked location.

4. Collect cued measurement and display the response for all receivers and transmitters combinations and the inversion result.
5. Verify the response of the non null-coupled receivers when the Z-component transmitter is firing is above noise levels. For receivers that are null-coupled with the function test item, verify the response when the X and / or Y horizontal transmitter is firing.

3.5.4. Photograph the Sensor

Using a cell phone or other camera, photograph the assembled sensor. Verify that the photograph(s) shows: a) the locations and orientations of the GPS/RTS and IMU sensors, b) the X and Y transmitter coils in cued mode to document their orientation, and c) the DAQ with all the cables plugged in.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the all the steps described in this SOP and the EM3D software user guide.

4.2. Output Data

The data from the spin and sensor function tests described in Section 3.5 will be recorded and the results saved in the project database. Also, the QC checklist in Attachment 1 of this SOP will be completed, signed, and filed with the assembly photograph(s) as proof of correct assembly.

5. Quality Control

As this definable feature of work is accomplished only during the preparatory phase, only preparatory QC checks will be performed on this activity. QC consists of performing the inspections on the Preparatory Phase Quality Control Checklist that is included as Attachment 1 to this SOP. This checklist will be completed by the Field or Project Geophysicist and will be reviewed by the QC Geophysicist who will document the implementation of this SOP.

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly instructions have been followed. The MPV will not be tested on the IVS (see SOP 2) until this has been documented as described below.

6. Reporting

Achievement of the Sensor Assembly MQO will be documented by the Field or Project Geophysicist by completion of the Preparatory QC Checklist (ANJV QC application) and will be verified by the QC Geophysicist.

The delivered data package for the assembled and tested MPV will be included in a section of the IVS Letter Report and will include:

- a brief description of the assembly and test process along with the photograph(s) required by Section 3.5.4 of this SOP.
- the completed Preparatory QC Checklist signed by the Project or Field Geophysicists and checked by the QC Geophysicist verifying the assembly and orientation tests described above.
- the Sensor Function Test result.

7. Revision History

01-03-18 Initial release.

01/05/18 Added ANJV logo

10/23/18 Changed sensor function test procedures

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AcornSI and NAEVA JV
ADVANCED GEOPHYSICAL CLASSIFICATION

STANDARD OPERATING PROCEDURE 1T

Assemble the TEMTADS 2x2 System 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 TEMTADS 2x2 sensor system for dynamic collection and verifying that all components are correctly assembled, operating normally, and capable of acquiring quality data.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the TEMTADS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- TEMTADS 2x2 sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and Inertial Measurement Unit (IMU) for orientation measurements
- a schedule 80 small Industry Standard Object (small ISO80) in the Delrin mounting ring for sensor function testing
- a digital camera or cell phone. (Note, personnel should not have cell phones when operating the TEMTADS)

3. Procedures and Guidelines

The TEMTADS 2x2 is an advanced electromagnetic induction sensor designed for the detection and classification of buried metal objects. The sensor consists of four sensor elements arranged on 40-centimeter (cm) centers in a 2x2 array. Each sensor element consists of a 35-cm square transmit coil for target illumination with an 8-cm three-axis receive cube centered in the transmit coil. The transmitters are energized in sequence and the decay curve is recorded up to 25 milliseconds after the transmitters are turned off for each of the 12 (4 cubes with 3 axes each) receive channels. A schematic of the sensor coil configuration is shown on Figure 1.

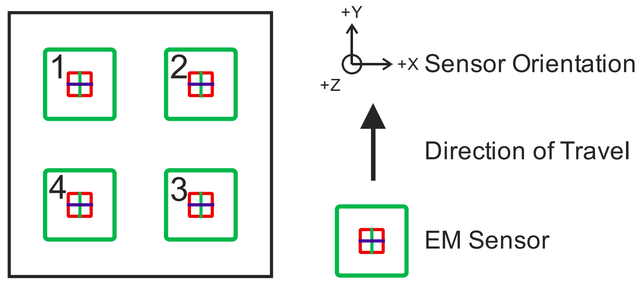

Figure 1. Orientation of the Four TEMTADS 2x2 Sensor Elements (topview)

Positioning of the TEMTADS 2x2 is accomplished using an RTK GPS or RTS. The TEMTADS 2x2 orientation is measured using a six-degree-of-freedom IMU. For proper functioning, it is important to verify that the IMU has been mounted to the TEMTADS 2x2 in the correct orientation.

3.1. Assemble the TEMTADS 2x2

All assembly operations are described in the TEMTADS 2x2 unpacking instructions and user guide (TEMTADS MP Users Guide v2.0.pdf) available from the Naval Research Laboratory (NRL) and the detailed instructions contained there should be followed precisely. The assembly steps include:

1. Remove the sensor assembly from the packing crate.
2. Attach handles, wheels, or sled as appropriate.
3. Securely attach the GPS antenna or RTS prism to the top of the mounting platform. If GPS/RTS is not being used, move to Step 4.
4. Set the IMU onto its position below the GPS antenna/RTS prism. The attachment will be secured after correct IMU orientation is verified.
5. Connect the sensor cable bundle to the sensor. This includes the sensor Tx and Rx cables and the cables to the GPS/RTS and IMU.
6. Remove the electronic housing from its shipping container and attach it to the backpack.
7. Attach the Tx, Rx, and IMU cables to the electronics box. The GPS/RTS cable will be attached after booting the computer.

3.2. Turn On and Initialize the Data Acquisition Computers

Following the instructions in Section 5 of the TEMTADS 2x2 User Guide, start the data acquisition system. After the main computer in the electronics housing boots, plug the GPS/RTS cable into the electronics. The last step in Section 5 involves observing the IMU output. Leave the system in this state for the next operation.

3.3. Verify IMU Orientation and Values

The procedure to verify the correct orientation of the IMU follow:

1. Facing the direction of travel, rotate the IMU around the along-track axis to produce a positive ROLL as shown in Figure 2. Verify that the data acquisition system records a positive ROLL, Figure 3. If it does not, reorient the IMU on its mount and test again.

Figure 2. Positive ROLL, PITCH, and YAW Rotations of the IMU

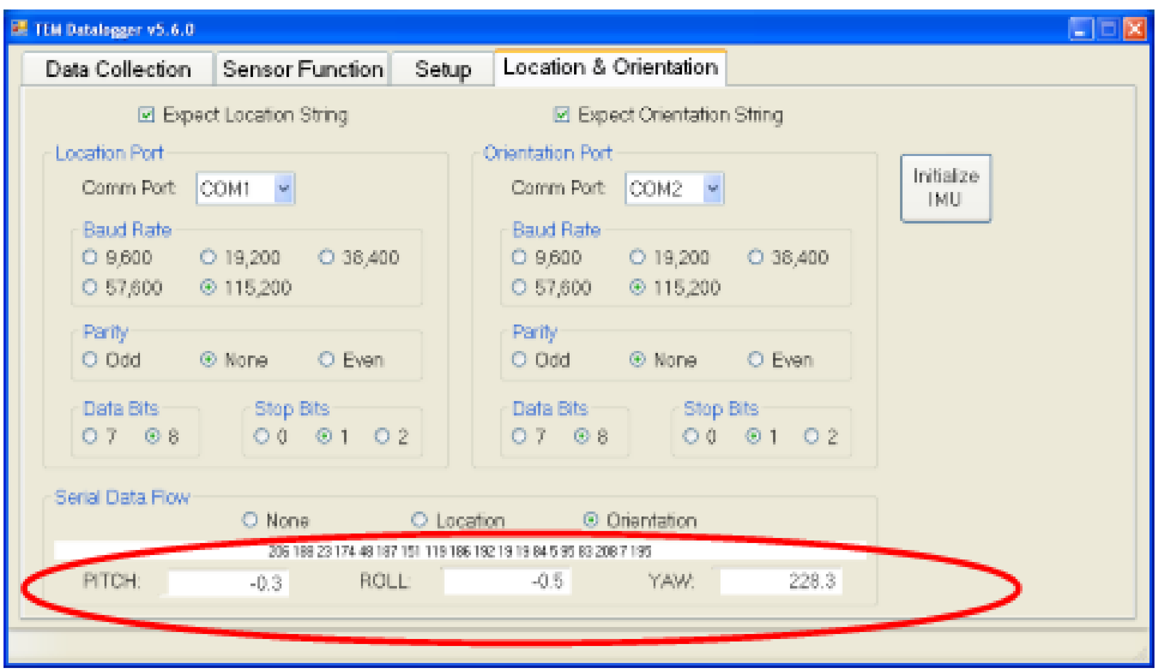

Figure 3. Electronics Box Screen Showing Orientation Inputs

2. Standing on the side of the sensor with the direction of travel to your right, rotate the IMU around the cross-track axis to produce a positive PITCH as shown in Figure 2. Verify that the data

acquisition system records a positive PITCH. If it does not, reorient the IMU on its mount and return to step 1.

3. Looking down on the sensor from above, rotate the IMU around the vertical axis to produce a positive YAW as shown in Figure 2. Verify that the data acquisition system records a positive YAW. If it does not, reorient the IMU on its mount and return to step 1.
4. Use a cell phone applet, such as SPIRIT Level, to verify that the roll, pitch, and yaw readings are not materially biased. To verify, start Spirit Level (or similar app) on the phone, place the phone on the sensor frame such that it is on the same plane as the IMU sensor, and verify that the readings using the cell phone application agree with the IMU values on the data logger to within 2 degrees (Figure 4). If the difference is greater than 2 degrees perform the “Capture Gyro Bias” procedure and return to step 1. If the difference is greater than 2 degrees after performing the “Capture Gyro Bias” procedure, document the measured bias in the field notes. If the difference is less than 2 degrees, the test is deemed successful and is documented in the field notes.

Figure 4. Cell phone running SPIRIT Level, an independent measurement of sensor roll and pitch, to guard against materially significant bias in the IMU sensor.

3.4. Photograph the Sensor

Using a cell phone or other camera, photograph the installed sensor. Verify that the photograph(s) shows the locations and orientations of the GPS/RTS and IMU sensors.

3.5. Set up the Data Acquisition Parameters

In preparation for the sensor function test, use the [Setup] tab in TEMDataLogger or TEMTablet to set the correct data acquisition parameters for the dynamic survey. The easiest way to accomplish this is to use [Standard Dynamic] or [Standard Cued] button, Figure 5. The standard parameters are listed in Table 1.

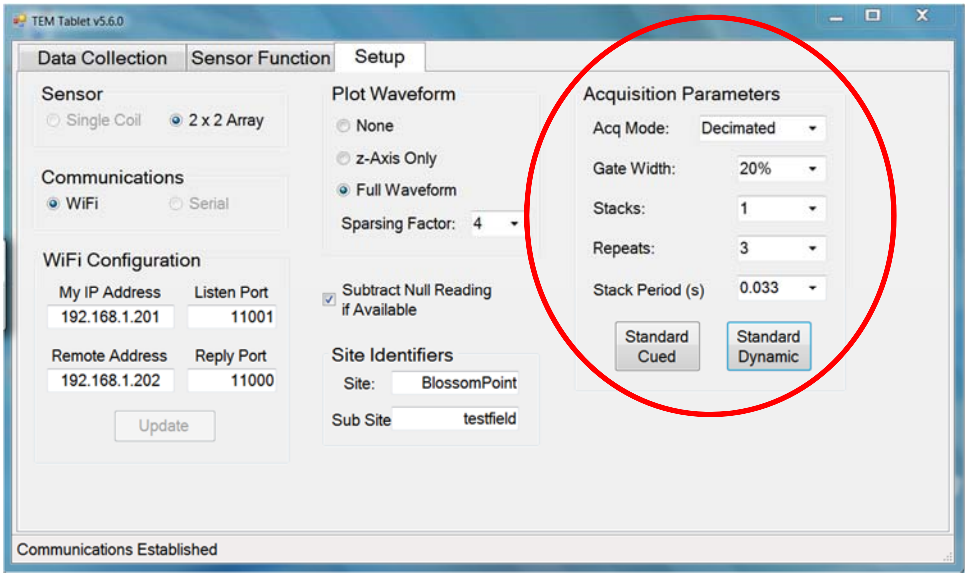

Figure 5. Standard Acquisition Parameters for Dynamic Surveys

Table 1. Standard Data Acquisition Parameters

Parameter	**Cued Survey**	**Dynamic Survey**
Acq Mode	Decimated	Decimated
Gate Width	5%	20%
Stacks	18	1
Repeats	9	3
Stack Period	0.9	0.033

3.6. Perform a Sensor Function Test

If there is a reference response for the combination of hardware and data acquisition parameters you are using, the [Sensor Function] tab will be available on the data acquisition computer. Access that tab to perform a sensor function test.

1. Position the sensor in a spot known to be clear of buried metal. Often the clear position in the Instrument Verification Strip (IVS) will be the best choice. Collect a background measurement from [Sensor Function] tab of the data acquisition software.

2. Without moving the sensor, mount the ISO80 test item in the hole on the top of the sensor housing (Figure 6).
3. Collect sensor function data. If the results agree with the reference values, a green LED is displayed. If they do not agree, a red LED is displayed and a summary of the incorrect results is displayed.
4. Transfer the background and sensor function data files to the Data Processor/QC Geophysicist for archiving.
5. The Data Processor/QC Geophysicist will verify the sensor function test using the purpose-built tool “Sensor Function Test” in UX-Analyze.

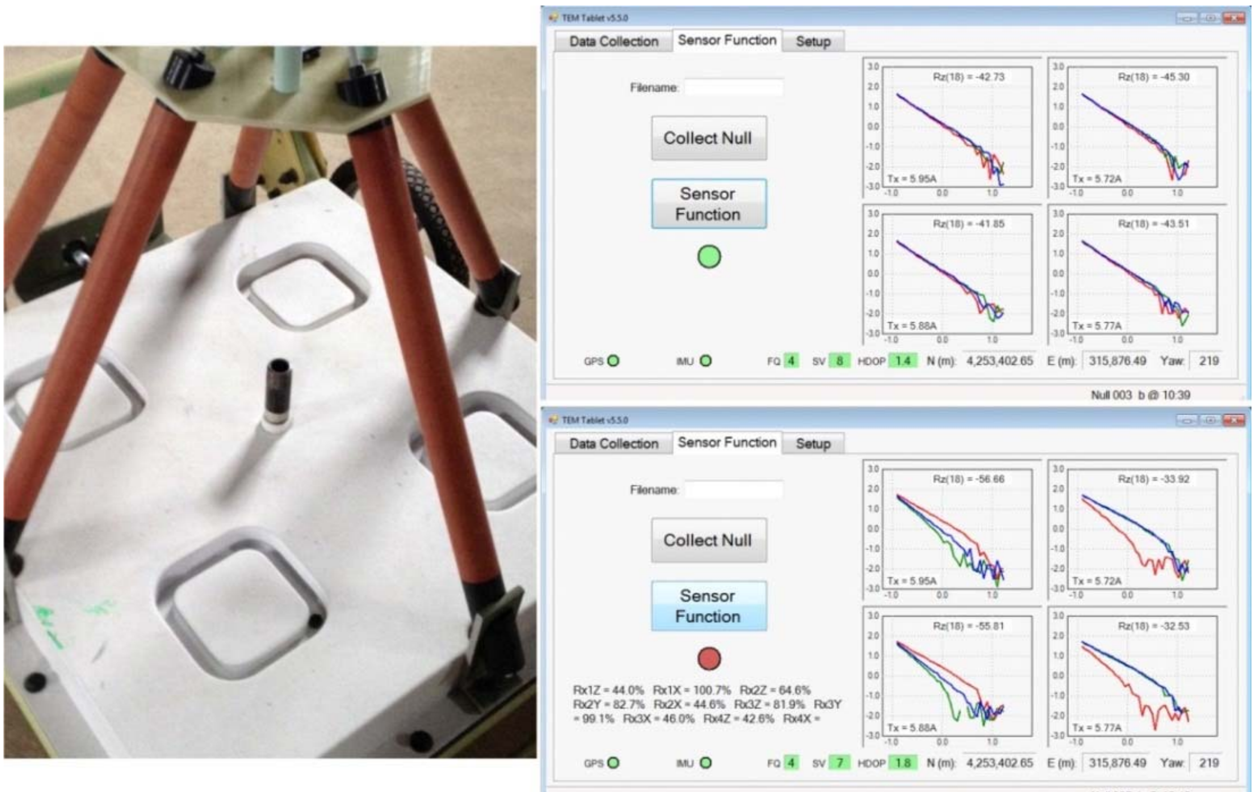

Figure 6, left panel – photograph of the standardized test object on the TEMTADS sensor. Right panel – screen snapshots of the data logger

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the assembly and operation instructions for the TEMTADS 2x2 contained in the unpacking instructions and user guide available from NRL.

4.2. Output Data

The sensor function test described in Section 3.6 will be saved in the project database. Also, the QC checklist in Attachment 1 of this SOP will be completed, signed, and filed with the assembly photograph(s) as proof of correct assembly.

5. Quality Control

As this definable feature of work is accomplished only during the preparatory phase, only preparatory QC checks will be performed on this activity. QC consists of performing the inspections on the Preparatory Phase Quality Control Checklist that is included as Attachment 1 to this SOP. This checklist will be completed by the Field or Project Geophysicist and will be reviewed by the QC Geophysicist who will document the implementation of this SOP.

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly instructions have been followed. The TEMTADS 2x2 will not be tested on the IVS (see SOP 2) until this has been documented as described below.

6. Reporting

Achievement of the Sensor Assembly MQO will be documented by the Field or Project Geophysicist by completion of the Preparatory QC Checklist (ANJV QC application) and will be verified by the QC Geophysicist.

The delivered data package for the assembled and tested TEMTADS will be included in a section of the IVS Letter Report and will include:

- a brief description of the assembly and test process along with the photograph(s) required by Section 3.4 of this SOP.
- the completed Preparatory QC Checklist signed by the Project or Field Geophysicists and checked by the QC Geophysicist verifying the assembly and orientation tests described above.
- the Sensor Function Test result.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

1-5-18 Added ANJV logo

10-23-18 Removed reference to specific title of IVS report

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STANDARD OPERATING PROCEDURE 3

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 or validation seeds in the production area.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in production area seeding:

- Project Geophysicist
- QC Geophysicist

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. Information on the specific qualifications for various UXO personnel support roles can be found in the project Health and Safety Plan.

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- inert munitions and industry standard objects (ISO) to emplace the seeds
- hand-held geophysical sensor (typically a Schonstedt magnetic locator or White's metal detector)
- hand tools including shovels, pick axes, breaker bars, etc. to emplace the seeds
- excavators if required by the production seed plan
- RTK GPS or RTS unit to record the location of seed items
- meter stick 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

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 demonstration area will contain some metallic items or electromagnetically active geology. These 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 strong anomalies. Figure 1 describes the process that should be used to avoid strong anomalies when emplacing a seed. First, the emplacement team should acquire the seed's intended location. Then, the team should use a hand-held instrument to survey within the immediate vicinity (30 to 40 cm radius) of the intended location. If there are no strong 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 strong anomaly, then the team should select a new location for the seed, as close as safety allows. The new location should ***not*** be within the immediate vicinity of any strong anomaly and should ***not*** be within 60 cm of another seed.

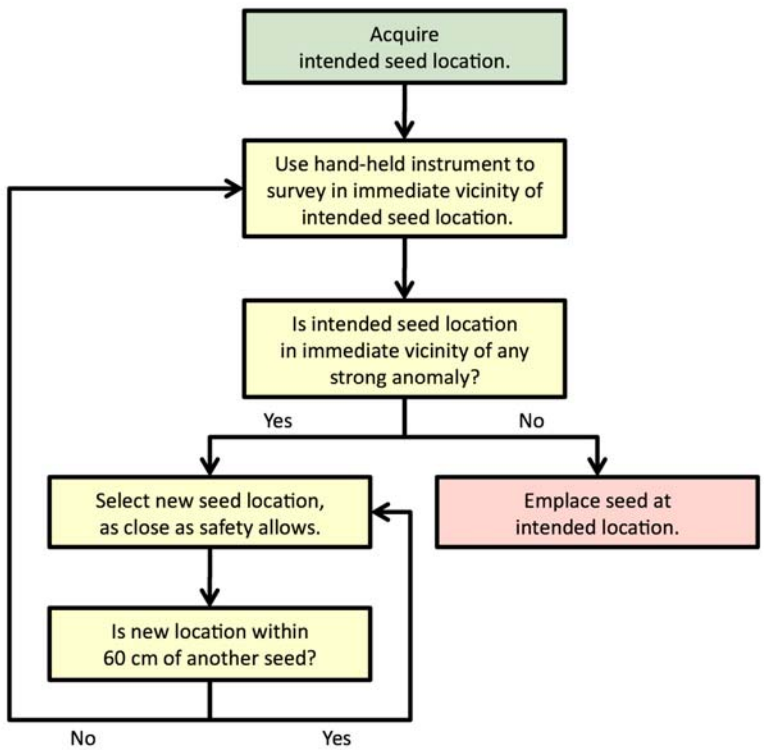

Figure 1: Anomaly avoidance during seed emplacement.

3.2. Seed Emplacement

The study will attempt to reconstruct the physical parameters of the buried targets, such as location, depth, inclination, azimuth, and size. Therefore, 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 fashion to minimize seed migration (e.g., settling) after burial.

The production area seed plan specifies the seeds' intended burial parameters. The intended locations are given to 1 cm precision, with the intended depths to 2 cm precision and the intended inclinations and azimuths to 15 degree precision. All locations should be acquired as accurately and precisely as possible before digging begins, as this ensures anomaly avoidance. Locations should be surveyed relative to a cm-level control point.

This plan is merely a ***guide*** for seed emplacement. The emplacement team may allow small deviations from the intended burial parameters listed in the attached spreadsheet. This variation is desired and the exact parameters should be recorded by survey. For example, the inclinations are specified to within 45 degrees of horizontal or vertical down. Therefore, the emplacement team should avoid burying the seeds exactly horizontal or exactly vertical down. In addition, the emplacement team should adjust the inclination angles of the seeds to ensure 5 cm of overburden.

After emplacing a seed in the ground, but before covering it with dirt, the following information should be carefully recorded:

- the x, y, and z coordinates for the center of the seed, with coordinates reported in UTM (NAD 83) meters
- the depth of the seed, 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
- a 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:

- ensure the seed is marked with blue paint (inert).
- replace any metallic items that were found in the hole (i.e., emplace the metallic items in the hole along with the seed).
- replace dirt in the hole as completely as possible.
- level the burial location.
- replace the grass plug over the burial location (if possible).

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

The production area seed plan which contains a table of seed items, initial locations, and depths and orientations is required for this SOP.

4.2. Output Data

The output data from this SOP is the final production area seed report. This report consists of a brief narrative describing the seed emplacement and a discussion of significant deviations from the seed plan. The bulk of the report 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.

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

This procedure will be documented through the completion of the Preparatory QC Checklist (ANJV QC application). Production area seeding will be documented in Production Area Seed Report as described in Section 4.2.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

1-5-18 Added ANJV logo

QC Seed Firewall Plan
March 2019

The QC Seed Firewall Plan describes the procedures that will be followed to ensure a firewall between the Quality Control (QC) seed item information and ANJV production personnel.. The plan also provides a list of those personnel with a 'need to know' who will be given access to the QC blind seed ground truth. The ground truth includes the seed types, depths and location information.

This document does not address the validation seed (aka., quality assurance) ground truth.

Access to this Blind Seed Firewall Plan will not be limited.

Personnel with Access to QC Blind Seed Item Information

The following personnel will have access to the QC blind seed item information.

- ANJV Senior AGC Geophysicist
- ANJV QC Geophysicist
- EA Seed Lead
- EA Project Manager
- EA Unexploded Ordnance Quality Control Specialist

The ANJV Senior and QC Geophysicist will not be involved in data processing, analysis, or classification activities.

Description of QC Information Addressed by this Plan

The following QC information will be made available to the employees listed above:
1. The QC Seeding Plan.
2. The QC blind seed item information; to include, coordinates, depth, orientation, photographs, and descriptions.

Storage and Transfer of QC Seed Ground Truth

The QC seed data and associated information will be recorded by the EA Seed Team Lead upon placement of the seeds in the field. 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 ANJV file server accessible only to the staff listed above and the server administrator.

QC data will be released to ANJV analyst on a Delivery Unit basis after successfully locating and classifying all QC seeds located within the subject Delivery Unit. QC seed information will not be shared with excavation teams.

If the QC blind seed information is needed by ANJV personnel other than those listed above for a post-classification root-cause analysis, information sharing will be done only after documented permission has been received from the USACE PM or QA Geophysicist.

STANDARD OPERATING PROCEDURE 4

Perform Dynamic Surveys - Advanced EMI sensor

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when performing dynamic surveys using an advanced electromagnetic induction (EMI) sensor (MetalMapper, TEMTADS, MM2x2, MPV, etc.) for target detection.

Dynamic advanced EMI data collection involves navigating the sensor along transects at a transect spacing designed to meet the project objectives with respect to detection performance of suspected targets of interest (TOI) in the subsurface. The detection objectives and resultant transect spacing are identified in the project-specific QAPP.

The observed signal measured by the advanced EMI sensor is composed of 1) the EMI response of potential buried targets, 2) the self-signature of the sensor system, and 3) any response from the ambient environment in which the target is buried. To isolate responses associated with buried discrete metal objects, a background model comprised of the latter two contributing signals must be derived and removed from the raw data. The resulting 'leveled' signal data, (raw data – background model) are used as inputs into a detection algorithm where anomalous responses due to potential targets of interest are mapped and selected for further investigation. Details of the data processing and analysis of dynamic data are covered in SOP 5.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment, and materials required to implement this SOP.

The following individuals will be involved in the collection of dynamic survey data:

- Project Geophysicist
- QC Geophysicist
- Field Team Leader
- Data Processor

The personnel qualifications are documented in the QAPP Worksheet #4, 7 & 8.

Required equipment includes:

- Advanced EMI sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and orientation sensor
- transport vehicle (skid steer, tractor, extended reach forklift) used to move the MetalMapper during data collection
- Tablet
- field survey grade tape measure

Required material may also include

- traffic cones or equivalent for lane marking, or
- marking paint

3. Procedures and Guidelines

3.1. Survey Grid Preparation

Grid preparation involves demarking the site boundaries and survey transects required to achieve the coverage specified in the project-specific QAPP. The site will be subdivided into grids with sizes depending upon the site conditions such that the sensor can be precisely navigated along the desired transect. Line guidance methods will vary according to the advanced sensor used but will either use manual methods or software based navigation. In the manual method, the transect ends will be measured and pre-marked and traffic cones may be used to identify the start and end of each transect. In the software based method, survey transect locations will be generated using the "survey layout" function in UX-Detect. The generated lines will be exported in a .XYZ file that can be imported into EM3D, the data collection software.

3.2. Function Test Measurements

Function test measurements (described in SOP 1) will be performed in conjunction with background measurements to confirm that all transmit and receive components of the sensor are operational.

3.3. Daily IVS Survey

Prior to the start and at the end of each day of data collection, measurements of the set of IVS targets will be performed (described in SOP 2).

3.4. Dynamic Data Collection

Dynamic survey for DGM involves collecting data along transects across the survey area. In combination with SOPs for sensor assembly (SOP 1) and testing at the IVS (SOP 2), in-motion data is collected along each transect at a spacing appropriate to the site and project needs, as defined in the project-specific QAPP. Data collection is controlled by the user with the EM-3D software, which allows the user to assign a numerical ID to each transect line and start/stop data collection at the beginning/end of each transect. When an obstacle is encountered along a transect, the obstacle can be avoided by either altering the path of the transect or stopping data collection when the obstacle is encountered and resuming a new ID transect on the other side of the obstacle. Data gaps that are the result of obstacles should be recorded by the field geophysicist and submitted to the data processor. Data gaps that are the result of line spacing over the defined acceptable spacing will be determined by the data processor and provided to the field geophysicist for recollection. Data acquisition will be performed using the following steps:

1. **Start-up and test the advanced EMI sensor**. The geophysical and navigation systems are started and a function test is performed prior to every data collection sortie (event). In addition, the

data acquisition software is monitored to ensure that all data streams (EMI, global positioning system, [GPS], or RTS and inertial measurement unit [IMU]) are valid and being recorded.

2. **Navigate and collect data along transects**. Navigation along transects is either performed visually with the assistance of markers, which are determined at the discretion of the field geophysicist or by following the preloaded survey lines plotted on the data acquisition screen When using visual navigation, markers may include, but are not limited to, ropes, tapes, spray paint, or flags. These markers can be used to show the track of the inside wheels as the sensor moves along a transect. Positioning in the data is captured through the use of the RTK GPS or RTS system and the IMU.
3. **Verify the integrity and quality of the collected data**. During data acquisition, the integrity and quality of the data will be verified by the operator by inspection of the data collection screen to ensure that:
   - the data collection starts and stops in coordination with the beginning and end of each transect.
   - the transmit current for each transmitter was within an acceptable range.
   - each transect is assigned a unique numerical identifier (ID), in sequential order.
   - the amplitude responses measured by each receiver coil appear reasonable (i.e., not ‘flat-lined’).
4. **Verify complete coverage of survey area**. 100% coverage surveys will require appropriate line spacing (presented in QAPP Worksheet #12). Data gaps resulting from obstacles or inaccessible terrain will be marked and verified by the field geophysicist. Data gaps exceeding the MQOs identified QAPP Worksheet #22 will be reacquired using RTK GPS or RTS and recollected.

4. Data Management

4.1. Data Inputs

The data inputs required are:

- a list of coordinates identifying the site boundaries.
- a list of instrument verification strip (IVS) transect start and end points.

4.2. Data Outputs

The data outputs are:

- dynamic advanced EMI transect data over the IVS line and survey area.
- function test measurement data.
- raw field notes (pdf images of hand written notes).
- digital field notes (an excel or other digitally recorded table presenting data filenames as delivered and rectified field notes [i.e. differences between delivered digital filenames and field notes are resolved]).

5. Quality Control

Practical considerations limit the real-time quality control (QC) of the dynamic data acquisition activities to qualitative assessments. Quantitative QC and assessment of the collected data will be performed as part of SOP 5 dealing with the processing of dynamic advanced EMI sensor detection data. The Quality Control checklist presented as Attachment 1 to this SOP will be filled out and delivered as part of the reporting requirement for this SOP.

The measurement quality objectives (MQOs) for dynamic data acquisition are presented in Worksheet #22 of the project-specific QAPP. Performance relative to the MQOs will be assessed during the processing of the collected data (SOP 5). Dynamic advanced EMI sensor data will not be used to detect targets until these MQOs are met or until the project team agrees on modifications to these MQOs.

6. Reporting

Reporting of the activities associated with this SOP will consist of the digital copies of the field notes and completion of the checklist (ANJV QC application).

7. Revision History

3-13-17 Added ‘Revision History’ section to SOP.

12-13-17 Revised text to be suitable for advanced sensors in general and not specific to the TEMTADS and MetalMapper.

1/5/18 Added ANJV logo

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STANDARD OPERATING PROCEDURE 5

Process Dynamic Survey Data - Advanced EMI sensor

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when processing dynamic survey data collected using an advanced electromagnetic induction (EMI) sensor (MetalMapper, TEMTADS, MM2x2, MPV, etc.) for target detection.

Dynamic advanced EMI data collection involves navigating the sensor along transects at a transect spacing designed to meet the project objectives with respect to detection performance of suspected targets of interest (TOI) in the subsurface. The detection objectives and resultant transect spacing are identified in the Geophysical Classification for Munitions Response (GCMR) Quality Assurance Project Plan (QAPP). Processing the dynamic data involves processing and assessing all QC tests (including daily function tests and IVS surveys), leveling the raw data to remove EMI signal due to the self-signature of the sensor systems and the ambient EMI soil response, and target selection.

A set of QC measurements are conducted upon initial commissioning of the system and on a daily basis to validate the operation of the various components of the advanced dynamic survey system.

In the dynamic survey data, the observed signal measured by the advanced EMI sensor is composed of 1) the EMI response of potential buried metallic objects, 2) the self-signature of the sensor system, and 3) any response from the ambient environment in which the target is buried. To isolate responses associated with buried discrete metal objects, a background model comprised of the latter two contributing signals must be derived and removed from the raw data. The resulting 'leveled' signal data, (raw data – background model) are used as inputs into a detection algorithm where anomalous responses due to potential TOI are mapped and selected for further investigation.

2. Personnel and Equipment

This section describes the personnel and equipment required to implement this SOP.

The following individuals will be involved in the analysis of dynamic data:

- Project Geophysicist
- QC Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The only required equipment is a data processing computer suitable for and equipped to run the processes provided in the UXA-advanced module of Geosoft's Oasis Montaj geophysical processing environment.

3. Procedures and Guidelines

This section describes the procedures used to process the dynamic production data including positioning and leveling of the data, process/assess the QC activities related to dynamic data collection, and select target anomalies from the final processed data.

3.1. Processing of Dynamic Advanced EMI data

The processing of dynamic advanced EMI data is achieved in the following steps:

1. Data import and QC
2. Data positioning and background removal
3. Target selection

3.1.1. Data Import/initial QC

The raw *.TEM data files are converted to ASCII *.csv files using Convert_TEMTADS (TEMTADS) or EM3D plot export utility (MetalMapper and MPV) and imported into a Geosoft Database (*.gdb) using a purpose built utility in UXA-Advanced. In the case of the MM2x2, the raw HDF5 files are directly imported into a Geosoft Database. Once imported the data are inspected and assessed against the measurement quality objectives (MQOs) provided in Worksheet #22 for:

- transmit (Tx) current within limits
- Global positioning system (GPS) fit quality
- valid inertial measurement unit (IMU) data
- EMI response signal not saturated

Data measurements that do not pass the MQOs are automatically identified by a purpose-built utility in UXA-Advanced that is used to default the associated data where the MQOs are not met. This prevents the out-of-specification data from being mapped and used for detection. The out-of-specification data are flagged in the databases and overall statistics for each of the data streams is calculated for each line collected and output as a plot and spreadsheet for reporting and documentation purposes.

3.1.2. Data Positioning and Leveling

A second purpose-built software routine automatically assigns the monostatic, Z-component EMI measurements positions based upon the GPS antenna or RTS prism location, platform geometry and platform attitude (IMU) data. If necessary, a latency correction is applied to correct instrument timing delay errors. A site-specific de-median filter is applied to the raw EMI data to derive an estimate of the background model. This model is subtracted from the raw data to provide a background removed or 'leveled' data set. Figure 1 shows an example of raw data (top panel, red trace), the background model derived from these data (top panel, green trace) and the resulting background removed data.

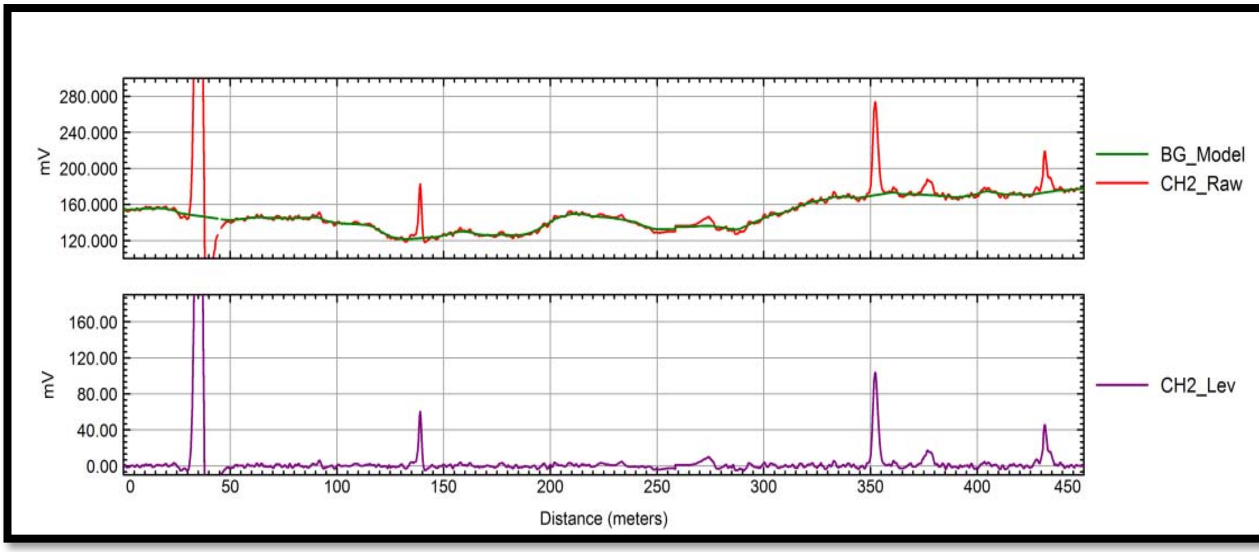

Figure 1. Example of Raw and Leveled Data

The leveled monostatic data are gridded and mapped using conventional Geosoft tools. The mapped monostatic Z-component data are then used for amplitude response based target selection whereby the position of peak responses in the data that exceed the project threshold are selected and identified as target anomalies for further analysis.

The gridded and mapped monostatic Z-component data are also suitable for use to select background locations, which in turn can be used to level all the Tx/Receive (Rx) coil combination data in a manner similar to that used for background removal of cued target measurements.

3.1.3. Target Selection

Target selection using the advanced EMI dynamic data is performed using the traditional amplitude response metric using the mapped Z-component data described above. Alternately a dipole response filter approach or other advanced anomaly selection technique that uses a larger subset of the available data can be used.

3.1.3.1. Response Amplitude Detection:

Traditional anomaly selection is based almost entirely on signal response amplitude. Using the advanced EMI dynamic survey monostatic Z-component response amplitude as a detection metric is essentially the same as using a Geonics EM61 response amplitude detection. After the data have been gridded, the Geosoft automatic grid peak detection algorithm is used to extract locations of all grid peaks that are above the project detection threshold. These target anomaly locations are reviewed by the project geophysicist and manual additions and deletions are made to this list. The final list is reviewed by the quality control (QC) geophysicist prior to finalization of the target list.

3.1.3.2. Dipole Response Filter Detection:

The 'dipole response filter' approach to anomaly detection makes use of the rich data set output of the advanced sensors. This target selection routine takes advantage of all the measured data – not just the monostatic Z component – by employing an automated dipole inversion routine to estimate the source locations. The process involves:

1. assuming a target's location (at every 10-20 centimeters [cm] spaced grid node across the site)
2. extracting data within a specified sensor footprint
3. inverting for dipole polarizations
4. extracting the 'goodness-of-fit parameter' as the detection metric

The 'goodness-of-fit' filter output is the squared correlation between the full multi-axis, multi-static advanced EMI data set and a dipole model fit to those data. This filter output is mapped in the same manner as the amplitude response and peaks in the detection metric indicate target locations as illustrated by Figure 2.

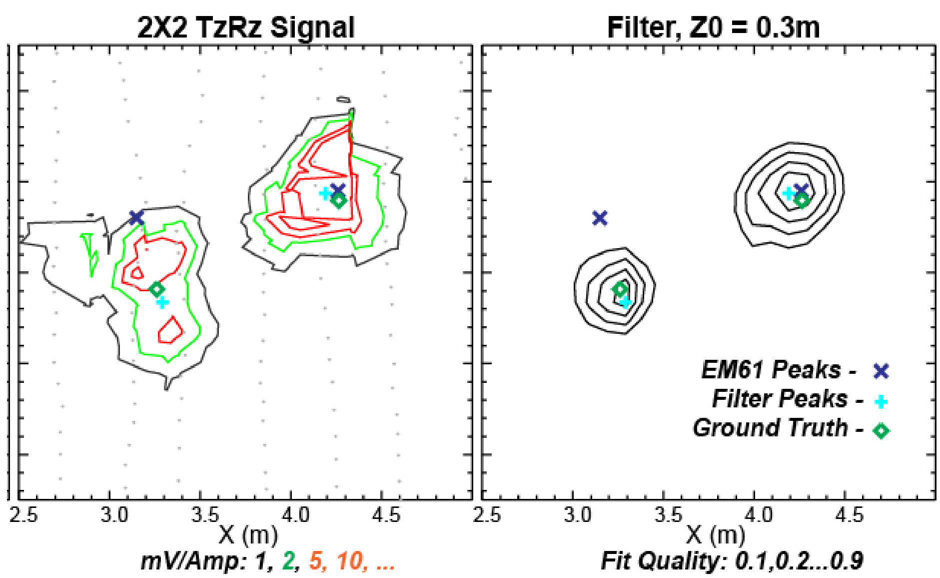

Figure 2. Data subset showing mapped response amplitude (left) and mapped filter response output (right) with ground truth information superimposed. Contour line values are provided in the legend.

Accordingly, target selection using the dipole filter fit coherence metric is accomplished in the same manner as for the amplitude response approach. After running the automatic peak detection routine, the target list will be reviewed and manual additions/deletions will be made. The automatic peak detection routine in UX-Analyze allows detections based on the amplitude response, dipole fit coherence or a combination of both. This target list is the input into the next stage of the source selection process which involves:

1. extracting data within a specified sensor footprint

2. inverting the data in separate passes for one, two, or three dipole sources, enabling spatial resolution for multiple sources within the footprint of the original dipole response region
3. resulting sources are examined and valid sources with at location greater than 0.45m from the original fit coherence peak require an additional inversion using data centered on the fit position of the source
4. inversion results for all sources are examined and optional screening of the sources based on size and decay metrics are performed
5. closely located valid sources (typically within 0.2-0.3m of one another but will vary according to the TOI) are merged into one source to form the final target list

3.2. Assessment of Quality Control of Dynamic Survey Data

During the course of a dynamic survey, QC measurements are performed on a daily basis to verify the operation of the sensor and associated components. These tests are comprised of function tests (described in SOP 1) and transects along the instrument verification strip (IVS). The successful completion of these tests on a daily basis is required to validate the survey data collected on that day.

3.2.1. Function Test Measurement Processing

Function test measurements (described in SOP 1) are performed prior to each sortie to confirm that all transmit and receive components of the advanced EMI sensor are operational. The data from each function test are assessed relative to the MQOs presented in Worksheet #22, compiled and presented in graphical form for review. Results that do not pass the MQOs are identified and the appropriate action specified in Worksheet #22 is taken.

3.2.2. Daily IVS Survey Processing

Prior to the start and at the end of each day of data collection, measurements of the set of IVS targets are performed (described in SOP 2). These data are processed in the same manner as the production survey data with regard to positioning and background removal. The data from each IVS test are assessed relative to the MQOs presented in Worksheet #22, compiled and presented in graphical form for review. Results that do not pass the MQOs are identified and the appropriate action specified in Worksheet #22 (root cause analysis (RCA)/corrective action (CA) are taken. Depending upon the findings of the RCA, the survey data associated with the IVS MQO failure may need to be re-collected.

4. Data Management

4.1. Data inputs

The data inputs required for processing dynamic advanced EMI data are:

- a list of coordinates identifying the site boundaries.
- raw Dynamic advanced EMI data files.
- amplitude response minimum detection threshold (derived from the project-specific QAPP).

4.2. Data Outputs

The data outputs of the processing of dynamic advanced EMI data are:

- QC reports summarizing daily QC measurement results
- mapped detection metric data (Z-component amplitude and dipole response coherence) in ASCII (x,y,z) and/or Geosoft database format
- target anomaly list (identifier (ID), X, Y)
- letter report detailing processing approach including leveling and target selection procedures

5. Quality Control

The Quality Control checklist (ANJV QC application) will be filled out and delivered as part of the reporting requirement for this SOP.

The MQOs for processing dynamic advanced EMI data are presented in Worksheet #22 of the project-specific QAPP. Performance relative to the MQOs will be assessed during the processing of the data. Dynamic advanced EMI data will not be used to select targets until these MQOs are met or until the project team agrees on modifications to these MQOs.

6. Reporting

Reporting of the activities associated with this SOP will consist of the following:

- digital Field notes
- data processing log detailing the following for each sortie (chronologically contiguous data collection set):
    - survey date
    - % invalid data with regard to transmit (Tx) current, GPS fix quality, IMU data quality, EMI response within range
    - standard quality control checks performance
        - correct coordinates for grids
        - coverage
        - line gaps
        - background response
        - dropouts
        - downline density
        - appropriate leveling
        - appropriate anomaly selection
    - associated Function Test filename
    - associate IVS Test filename(s)
    - area subset (grid ID)
- QC report summarizing daily QC results (Function tests and IVS tests)

- target List – final list of identified anomalies for delivered area subset
- final data archive (gdb or xyz format) for delivered area subset
- final grids of Z-component amplitude response for delivered area subset
- final grids of detection metric (if not amplitude response) for delivered area subset
- processing/data selection letter report

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

01-03-18 Revised text to be suitable for advanced sensors in general and not specific to the TEMTADS and MetalMapper.

1-5-18 Added ANJV logo

STANDARD OPERATING PROCEDURE 6

Collect Static Background Measurements

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when selecting the positions for background measurements using an advanced digital geophysical mapping system and verifying the usability of the resulting background data. The observed signal in a cued measurement using advanced sensors is composed of 1) the EMI response of the buried target, 2) the self-signature of the sensor system, and 3) any response from the ambient environment in which the target is buried. The objective of taking background measurements is to independently measure the last two contributors to the overall EMI response. These "non-target" values can then be subtracted from the overall signal response to determine the signal response from only the unknown buried object being evaluated. For this to be successful the background measurements must be collected in an area without any buried targets and with a geology representative of that where the unknown items are located. They must also be taken throughout the survey day because environmental changes such as large changes in ambient temperature, significant changes in background moisture (morning dew evaporating, rain showers passing through, etc.), or significant changes to the sensor itself (cable replacement, new GPS antenna, etc.) will cause the sensor or environmental contribution to the background reading to change.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the collection of background data:

- Project Geophysicist
- QC Geophysicist
- Field Team Leader
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Advanced electromagnetic induction (EMI) sensor (MetalMapper, TEMTADS, MM2x2, MPV, etc.) coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and orientation sensor
- a standard test object (Industry Standard Object (ISO), sphere, etc.) for sensor function testing

3. Procedures and Guidelines

Background measurements will be recorded no less than every two (2) hours throughout the survey day and at one or more geographic locations as required to document the EMI signatures of near-surface soils present at the site. Background measurements involve positioning the sensor and collecting static measurements over a pre-identified set of background locations. In combination with SOPs for sensor assembly (SOP 1) and testing at the IVS (SOP 2), background data are collected that are used to correct the static data described in SOP 7.

Prior to cued data collection, the correct operation of the geophysical sensor and navigation and orientation systems must be verified at the Instrument Verification Strip (IVS) as described in SOP 2.

3.1. Choose Locations for the Background Measurements and Verify Their Suitability

One or more locations for background measurements will be planned at each site. The number and location of the background measurements will be influenced by the following considerations:

- The background measurements should be collected at locations that are similar to that of the production survey area with regard to geophysical noise, terrain, geology, and vegetation. If these factors change appreciably, additional background measurements, taken at a more representative location, will be required.
- The background measurements should be collected at locations devoid of buried metal objects. If a suitable object free area cannot be identified, attempts should be made to create a “clear” 2-m square area by surveying and removing all metal objects. Once cleaned, the background measurements should be re-collected in the “clear” area.
- For efficiency, background measurements should be collected in areas that are close to the survey area(s) to minimize travel time.

Once an adequate number of background locations have been identified, an initial measurement should be collected over each of the background locations in turn as illustrated in Figure 1 on the next page.

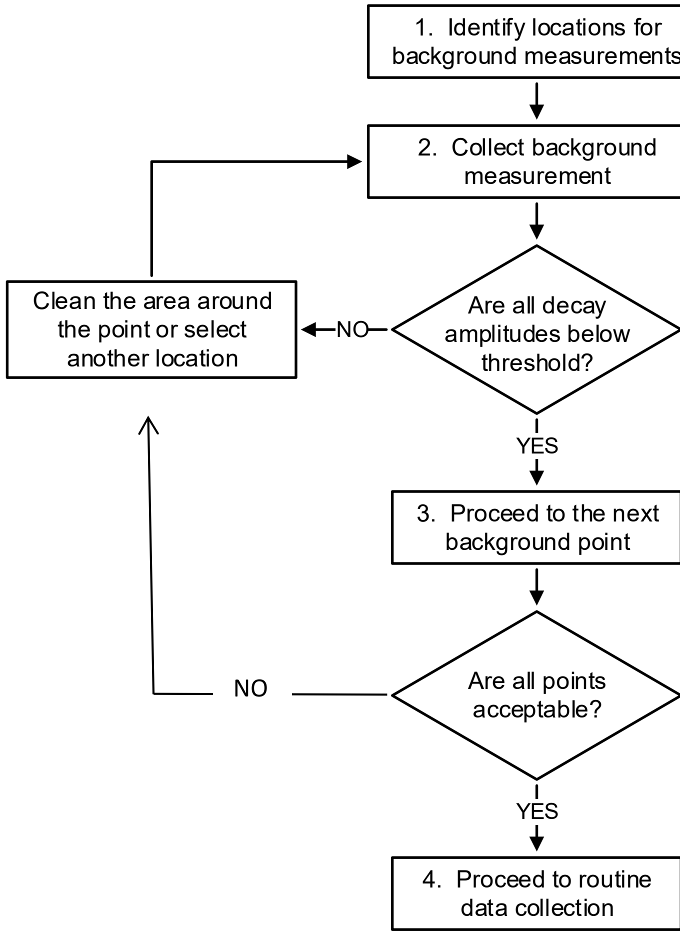

Figure 1. Choosing and verifying locations for background measurements

1. Initial locations for the background measurement are chosen most easily by referring to the dynamic survey data. These data can be used to guide the geophysicist to suitable locations that satisfy the considerations noted above.
2. Once an adequate number of initial locations have been identified an initial measurement should be collected over each of the background locations as follows:
   a. Center the advanced EMI sensor over the location chosen as a background point. Mark the corners of the sensor with non-metallic pin flags to allow this same location to be found again for future background readings.
   b. Record the stationary geophysical data at this location and verify that the signal amplitudes for all decays measured are below the threshold chosen for this project. If higher amplitude decays are observed, the location should be inspected and any metal contamination found should be removed. Alternatively, another nearby location can be chosen.
3. Each background location is verified by comparing a set of 5 measurements taken at the intended location: one measurement at the location and one more with the sensor offset by ½ sensor spacing in four orthogonal directions. Next, the forward model of the most challenging

target of interest / depth scenario (e.g. 37mm at 30cm depth) is added to the center background measurement and the background is verified by separately subtracting each of the 4 offset backgrounds and performing a library match to the target of interest. The background location is considered valid if the surrounding background measurements are collected within ½ sensor offset (±50%) of the center background, the ratio of the TOI amplitude to background is greater than the project threshold and/or the library match from all 4 offsets exceeds 0.85. These images will be saved and presented in a background summary report.

4. Continue this process at each of the chosen locations until their suitability for background measurements has been verified.
5. Once this process is complete, these measurements will serve as baseline values for succeeding background measurements at each point.

3.2. Collect Background Measurements throughout the Survey Day

Background measurements should be collected with a minimum spacing of two (2) hours throughout the survey day. Additional background measurements can be taken if the Project Geophysicist or Field Team Leader determines that changes made to the sensor or natural environmental changes may have caused the sensor or environmental contribution to the background reading to change. Careful field notes should be made to document the reasons for extra background readings to guide the Data Processor in choosing the correct background for each cued data set. As an additional check that the sensor is properly functioning, a sensor function test should be performed whenever a background measurement is taken.

The procedure for taking background measurements is as follows:

1. Return the sensor to one of the previously verified background measurement locations taking care to position the sensor as closely as possible to the initial location and orientation.
2. Collect a background measurement.
3. Without moving the sensor, mount the standard test item in the holder on the sensor housing
4. Collect sensor function data. If the results agree with the reference values, a green LED is displayed. If they do not agree, a red LED is displayed and a summary of the incorrect results is displayed.
5. Compare the Background transient data to the original data at this location.
6. Compare the Background transient data to passed measurements at this location.
7. If deviations exceeding the project thresholds exist, the background measurement is rejected unless environmental changes that may have led to this deviation are documented in the field notes and background use is approved by the Project Geophysicist.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

In initial list of suitable background locations, identified from the survey data, is required to begin this SOP. After the locations have been verified, they become the final background location list.

4.2. Output Data

The background data collected at each background location will be saved in the project database. Also, the QC checklist in Attachments 1 through 3 of this SOP will be completed, signed, and filed.

5. Quality Control

This procedure is performed throughout the project and, therefore, has Preparatory, Initial and Follow-on QC checks. Performance of the required QC checks will be documented on the Preparatory, Initial and Follow-on QC checklists in Attachments 1 -3 to this SOP as follows:

- The Preparatory Checklist (Attachment 1) will be completed to document the identification of the background locations.
- The Initial Checklist (Attachment 2) will be completed to document the initial background readings at each selected background location.

This procedure ensures that the advanced EMI sensor is working properly and that the field geophysical team is collecting data of adequate quality. Therefore, for routine background measurements, this procedure requires only Follow-on QC inspections which are documented through the following steps:

1. The operating software automatically logs the responsible geophysicist's identification in each data file. By logging the background data, and thereby taking responsibility for it, the geophysicist logging the data is certifying that they have complied with the requirements of this SOP.
2. The QC Geophysicist will observe background data collection each morning and afternoon of data collection activities and document this in the Daily Geophysics QC Report.
3. Achievement of the background collection and sensor function MQOs will be documented by the Field or Project Geophysicist and verified by the QC Geophysicist in the Geophysics Daily QC Report.
4. During review of each background measurement, the Data Processor will overlay the measured decays from all measurements at that location to observe any variation. Should variations be observed that are not the result of changing environmental conditions documented by the field crew, a comprehensive root-cause analysis will be performed and a corrective action determined.

The measurement quality objectives (MQOs) for background measurements are presented in Worksheet #22 of the QAPP. Measured backgrounds will not be used to correct field data until these MQOs are met or until the project team agrees on modifications to these MQOs.

6. Reporting

This procedure will be documented through the completion of the Preparatory, Initial and Follow-on QC Checklists (ANJV QC application) by the Field or Project Geophysicists. The completed checklists will be used to document the selection and preparation of the background areas (Preparatory Inspection Checklist in Attachment 1), the initial background readings taken at each selected area (Initial Inspection Checklist in Attachment 2), and the routine four-times-daily (at a minimum) background readings taken during the production survey (Follow-on Checklist in Attachment 3). The QC Geophysicist will observe the background readings being collected and will document completion of all checklists in the Geophysics Daily QC Report and copies of the completed checklists will be attached to the report.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

01-03-18 Revised text to be suitable for advanced sensors in general and not specific to the TEMTADS and MetalMapper

1-5-18 Added ANJV logo

10-23-18 Added sensor function test to background measurement procedures

STANDARD OPERATING PROCEDURE 7

Collect Cued Target Measurements

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when collecting cued measurements using an advanced electromagnetic induction (EMI) sensor (MetalMapper, TEMTADS, MM2x2, MPV, etc.) for target classification. Cued data collection involves navigating the sensor to the precise anomaly location, collecting static, advanced electromagnetic sensor data at this location, and verification of the integrity and validity of the collected data. Verification includes using the sensor data to derive an estimate of the target position relative to the center of the sensor. If this position estimate falls outside a predetermined threshold, the sensor will be repositioned, and a second data collection event will be performed.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the collection of cued target data:

- Project Geophysicist
- QC Geophysicist
- Field Team Leader
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Advanced EMI sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and orientation sensor

3. Procedures and Guidelines

Cued investigation for target classification involves positioning the sensor and collecting static measurements over a pre-identified set of anomalies. In combination with SOPs for sensor assembly (SOP 1), testing at the IVS (SOP 2) and collecting background measurements (SOP 6), a set of static data measurements are collected using an advanced EMI sensor over each anomaly. At each anomaly the data acquisition will be performed using the steps shown in Figure 1.

Prior to cued data collection, the correct operation of the geophysical sensor and navigation and orientation systems must be verified at the Instrument Verification Strip (IVS) as described in SOP 2. This will be verified by completion of the QC checklist attached to SOP 2.

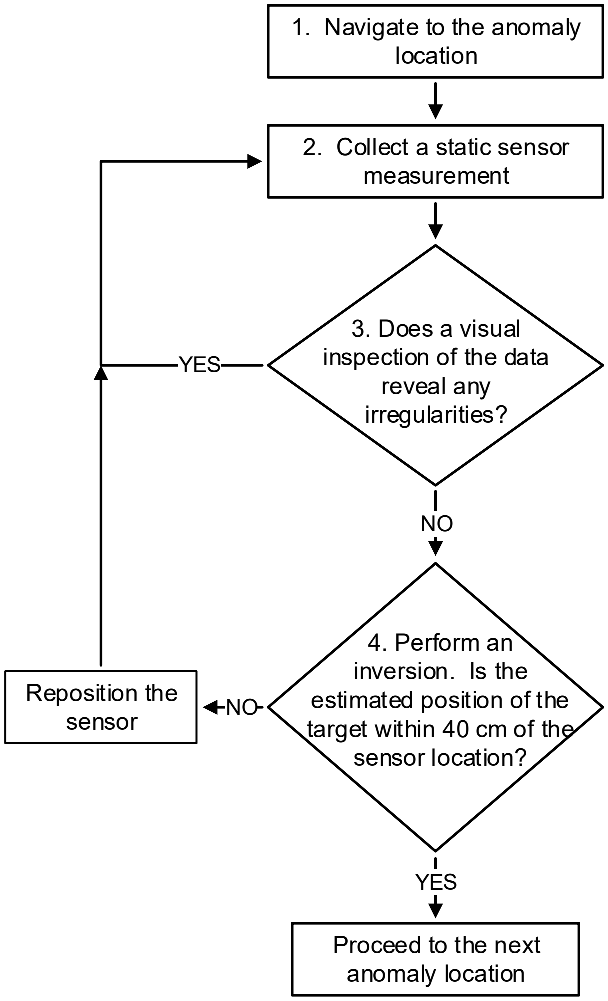

Figure 1. General procedure to collect a cued target measurement. The 40cm distance threshold is sensor specific.

The following is a description of each of the steps shown above:

1. **Navigate to the Anomaly Location**. Navigation to the anomaly location may be performed visually or through the use of the RTK GPS or RTS positioning system. Visual navigation requires marking the anomalies (usually with survey pin flags) in advance. Although some sensors may have the ability to direct the operator to an anomaly location based upon the geophysical signal received, the first measurement will be taken at the predetermined anomaly location as indicated by visual alignment with the pin flag or RTK GPS or RTS position relative to the predetermined position.

   If using flags, to implement this step, non-metallic pin flags will be placed at each anomaly location selected for cued measurement based on a target list generated from the dynamic data. If using RTK GPS or RTS, a list of points will be loaded into the survey software and each location navigated to within a few centimeters. A pin flag numbered with a unique target ID will be placed at that location. Once a number of locations have been flagged, the sensor will then be transported to and the center of the sensor positioned over the provided anomaly locations for cued measurements.

2. **Collect a set of static sensor measurements**. Initiate the collection of a set of measurements. During this measurement, care will be taken to ensure that the sensor does not move, and all external sources of EM signals (i.e. metal) are kept away from the sensor.

   Any metal associated with the sensor and deployment mechanism (e.g. console, support structures) that cannot be reasonably distanced from the sensor must be kept in the same physical relation with the sensor as was maintained during background measurements.

3. **Verify the integrity and quality of the collected data**. Immediately after data acquisition, the integrity and quality of the data will be verified by the operator by inspection of the advanced EMI sensor data collection screen to ensure that:
   - the data acquisition cycle completed properly.
   - the transmit current for each transmitter was within an acceptable range.
   - the decay curves measured by each receiver coil appear reasonable (i.e. – not 'flat-lined').
4. **Perform a field inversion**. Valid inversion results require that the target is located within a sensor specific distance from the center of the sensor. The distance is defined in Worksheet #22 of the project specific QAPP. Typical values are 40cm for the MM2x2, TEM2x2 and MM sensors and 20cm for the MPV sensor. The initial target horizontal position may be significantly offset from the center of the sensor for the following reasons:
   - positioning errors in the initial detection survey
   - imprecision in the derivation of the anomaly position from the detection survey data set
   - imprecision in the reacquisition and flagging of the anomaly
   - imprecision in positioning the sensor
   - the presence of multiple anomaly sources in relatively close proximity

   This step includes performance of an in-field inversion and inspection of the results to verify that the estimated horizontal target location is within the sensor specific distance of the center specification. After initiating the in-field inversion algorithm an estimate of the target location relative to the center of the sensor is provided. If the offset is greater than the sensor specific distance, position the sensor over the target location estimate provided by the in-field inversion (visually or using the RTK GPS or RTS data) and repeat Steps 1 and 2.

   This recollection should only be performed once. Assuming the repositioning was performed accurately, if the subsequent position estimate is still > the sensor specific distance from the sensor center, the cause is likely to be multiple anomaly sources and additional data collection and data analysis may be required after further analysis by the QC geophysicist. When moving to the next target, the flags (if utilized) may be bent, painted, or in some other way marked so as to visually track completed locations.

If more than one sensor is being used concurrently at a given site, adequate sensor spacing must be maintained to minimize interference. A minimum separation of 50m must be maintained for NRL TEMTADs and MetalMapper2x2 sensors. A minimum separation of 25m must be maintained for MetalMapper and MPV sensors.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

An anomaly list consisting of anomaly IDs and UTM Northing and Easting coordinates in meters.

4.2. Output Data

The output data from this SOP will consist of one raw sensor data file (.tem or .hdf5) per anomaly interrogated. These data files will be transferred daily (or more often as dictated by site procedures) to the data analyst.

5. Quality Control

The Preparatory and Initial QC checks for this SOP are performed during the implementation of SOP 2, "Test Sensor and System at the IVS". SOP 2 ensures that the advanced EMI sensor is working properly and that the field geophysical team is collecting data of adequate quality. Therefore, this procedure requires only Follow-on QC inspections which are documented through the following steps:

- The operating software automatically logs the responsible geophysicist's identification in each data file. By logging the data, and thereby taking responsibility for it, the geophysicist logging the data is certifying that they have complied with the requirements of this SOP.
- The QC Geophysicist will observe data collection each morning and afternoon of data collection activities and document this in the Daily Geophysics QC Report.

Daily data packages, containing the geophysical data from that day, will be reviewed by the QC Geophysicist to ensure that the Measurement Quality Objectives (MQOs) are being achieved. A comprehensive root-cause analysis will be performed and a corrective action will be determined if the QC Geophysicist determines that the MQOs are not being met or if a trend toward the MQO limits is observed.

The measurement quality objectives (MQOs) for cued target measurements are presented in Worksheet #22 of the QAPP. Cued data will not be used to classify targets until these MQOs are met or until the project team agrees on modifications to these MQOs.

6. Reporting

This SOP will be documented through the completion of the Follow-on QC Checklist (ANJV QC application). Since the Field Team Leader is certifying their compliance with this SOP every time they log data the Follow-on Checklist for this SOP will be completed by the QC Geophysicist and will document the successful completion of equipment start-up and the IVS (SOP 2) and the twice-daily (a.m. and p.m.) observation of data collection by the QC Geophysicist.

The Field Geophysicist will also maintain a field notebook and the QC Geophysicist will review this notebook daily to note issues that potentially affect quality. The completion of all checklists will be noted by the QC Geophysicist in the Daily Geophysics QC Report and a copy of the completed checklists will be attached to the report.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

3-16-17 Added the following text to the bottom of section 3… If more than one sensor is being used concurrently at a given site, adequate sensor spacing must be maintained to minimize interference. A minimum separation of 50m must be maintained for NRL TEMTADs sensors. A minimum separation of 25m must be maintained MetalMapper sensors.

01-03-18 Fixed typo "A minimum separation of 25m must be maintained for MetalMapper sensors.". Revised text to be suitable for advanced sensors in general and not specific to the TEMTADS and MetalMapper.

1-5-18 Added ANJV logo

10-23-18 Changed the 40cm distance tolerance to a general sensor specific value

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STANDARD OPERATING PROCEDURE 8

Process Cued Advanced EMI Sensor Data

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when processing cued measurements collected using an advanced electromagnetic induction (EMI) sensor (MetalMapper, TEMTADS, MM2x2, MPV, etc.) for target classification. Cued surveys include the collection of cued data over predetermined target locations and background locations. Cued measurements are also performed over instrument verification strip (IVS) targets for quality control (QC) purposes. This SOP details the steps required to verify the quality of these measurements, process these measurements to derive features related to the physical characteristic of the target, and use these features to classify the targets.

2. Personnel, Equipment and Materials

This section describes the personnel and equipment required to implement this SOP.

The following individuals will be involved in the processing of cued advanced EMI sensor data for advanced analysis:

- Project Geophysicist
- QC Geophysicist
- Field Team Leader
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 and 8.

The only required equipment is a data processing computer suitable for and equipped to run the processes provided in the UXA-advanced module of Geosoft's Oasis Montaj geophysical processing environment.

3. Procedures and Guidelines

3.1. Data Import/Initial QC

The raw *.TEM data are converted to ASCII *.csv files using:

- a purpose built software utility (Convert_TEMTADS) supplied by the Naval Research Lab (NRL) or
- the EM3D Plot export utility

The data are then imported into Geosoft's UXAnalyze-Advanced (UXA) purpose built processing environment. This process results in separate databases that contain:

- target anomaly measurement data
- background measurement data

- target list
- background list

The cued measurements from the advanced EMI sensor go into the target anomaly or background databases and the Target list is where the sensor parameter information and QC results for each target are summarized. The initial flag locations of the cued measurements are also merged into the target list database.

Once imported the data are inspected and assessed against the measurement quality objectives (MQOs) provided in QAPP Worksheet #22 for:

- Transmit (Tx) current within limits
- Global positioning system (GPS) fit quality
- valid inertial measurement unit (IMU) data
- EMI response signal not saturated
- Distance of sensor array to flag location

3.2. Background Corrections

Background corrections are used to remove the self-signature of the advanced sensor system and the soil response from the measured anomaly data. Background measurements are taken at locations selected from the detection survey data set. Prior to utilizing these locations for background measurements, they need to be verified to be devoid of metal. Additionally, each background measurement needs to be verified as suitable prior to using it for background correction of the target measurement data.

3.2.1. Background Location Verification

Each background location is verified by comparing a set of measurements taken at the intended location: one measurement at the location and one more with the sensor offset by ½ sensor spacing in four orthogonal directions. Next, the forward model of the most challenging target of interest / depth scenario is added to the center background measurement and the background is verified by separately subtracting each of the 4 offset backgrounds and performing a library match to the target of interest. The background location is considered valid if the surrounding background measurements are collected within ½ sensor offset (±50%) of the center background, the ratio of the TOI amplitude to background is greater than the project threshold and/or the library match from all 4 offsets exceeds 0.9. This process is automatically performed and the metrics are calculated using the purpose-built tool “Background Location Validation Test” in UX-Analyze. The tool generates images and a spreadsheet tabulating the metrics for each background location to be presented in a background summary report. A database containing the only the background locations that passed the test is generated for use to test subsequent background measurements.

3.2.2. Background Measurement Verification

Individual background measurements must be verified prior to their use for background corrections. The purpose-built tool "Calculate Background Database QC stats" is used to compared to the initial background verification measurement at the same position and verified as qualitatively similar. This tool performs the following calculations for each background measurement:

i. finds the closest verified background location and verifies its location is within ½ sensor width
ii. calculates the amplitude percent difference to the closest verified background location
iii. calculates statistics of all backgrounds at the same location

Using UX-Analyze's decay plot utility, all the background measurements for each background location are overlain and inspected. Based upon the quantitative metrics output and a qualitative assessment of the results, backgrounds showing a significant variation between measurements are rejected. These images will be saved and presented in a background summary report. Invalid measurements will be removed from background database to ensure that they are not used.

3.2.3. Background Corrections

Background corrections are applied using a purpose-built tool in UX-Analyze that automatically finds the closest background (chronologically and spatially) and will only apply the background corrections that were collected within a preset time limit relative to the target measurement. This preset time limit will be set to 2 hours. The background corrected data are stored in a separate channel. This leveled data channel is submitted to the inversion processes to derive target features. This data channel will not be populated for those target measurements that do not have a suitable background measurement within the 2 hour time limit. A report is automatically generated from the software that tabulates the target measurements that do not have a suitable background measurement.

3.3. Function Test Measurements

Function test measurements (described in SOP 1) are performed in conjunction with the background measurements to confirm that all transmit and receive components of the advanced EMI sensor are operational. These data are background corrected, then the monostatic components are compared to a benchmark set of values to confirm that all components are fully operational. This comparison is performed in the field and the results are provided in real time. The data processor should use the purpose-built tool in UX-Analyze to verify and log the results for QC/quality assurance (QA) purposes.

3.4. Target Feature Estimation

After background corrections are applied, intrinsic and extrinsic features are estimated for the target anomalies as well as the daily QC measurements collected at the IVS.

N-dipole target inversion routines in UX-Analyze are used to determine the parameters of a target (single-target inversion), or constellations of targets (multi-target inversion), that would produce responses that closely match the observed responses. These parameters include extrinsic parameters (location and orientation) as well as the intrinsic parameters (principal axis polarizabilities) related to the object size shape and composition. The intrinsic parameters, otherwise known as betas (β) are used for classification.

The "N" in the N-dipole solver indicates the number of sources the solver presupposes. The default setting is to run 1, 2, and 3 source solvers for each cued measurement. The number or sources can be increased if ground truth, training data or other information suggests the 3 source model is insufficient to extract accurate target parameters. A separate fit coherence value is derived for each solution and can aid in this determination. Model results will only be used for classification if they pass the MQOs identified to confirm that they support classification (QAPP Worksheet #22).

3.5. Daily IVS Survey

Prior to the start and at the end of each day of data collection, measurements of the set of IVS targets are performed (described in SOP 2). These measurements are processed as described above and the derived features are assessed against the MQOs presented in WS #22. These results are documented and summarized in a QC report to be generated for each delivered prioritized list.

3.6. Classification

Classification of targets will be based upon objective, numeric criteria. Using these criteria, a prioritized list is created with high likelihood target of interest (TOI) placed at the top of the dig list (just after digs classified as "training data" and "can't analyze") and high likelihood non-TOI placed at the bottom of the list. The primary method for classification will be library matching, supplemented by cluster analysis and feature space analysis.

3.6.1. Library Matching

Classification is based primarily on the goodness of fit metric (values from 0.0 to 1.0) generated by UXA during a comparison of the β values estimated for each surveyed target and the β values in the munitions library developed for the project. This comparison is performed via the library match utility in UX-Analyze. The goodness of fit metric is a measure of the amplitude and shape mismatch between a target and the library entry that best fits that target, with higher values indicating a better match between the target and the corresponding item in the library. The library fit analysis matches the following four combinations of βs to those of the candidate library TOIs:

- $\beta 1$, $\beta 1/\beta 2$, $\beta 1/\beta 3$
- $\beta 1$, $\beta 1/\beta 2$
- $\beta 1/\beta 2$, $\beta 1/\beta 3$
- $\beta 1$

The confidence metrics for each fit combination are averaged to derive a 'decision statistic'. This library matching process is performed on each source output from the N-dipole solver. For each flag position, the best decision statistic is used from all the sources to rank and classify the target list. Values below the analyst's threshold (nominally 0.85) are considered non-TOI.

A set of training digs are identified by the analyst. The intrusive investigation results of these digs as well as decision metrics derived for other known TOI (IVS and seed items) are used to finalize the analyst threshold.

3.6.2. Cluster Analysis/Feature space Analysis

Cluster analyses are performed whereby the clusters of anomalies with similar β signatures are identified using the self-match utility in UX-Analyze. For each identified cluster, a representative sample is intrusively investigated as part of the training data. If the intrusive investigation identifies a hazardous item, a representative signature is placed in the site-specific library and the matching process will be repeated to ensure that all similar items are classified as TOI.

Individual items that do not match any library items but have βs that indicate a large, axially symmetric, thick-walled object are identified and investigated as part of the training data and added to the library if they are identified as TOI.

3.6.3. Site Specific Munitions Library

A site-specific library of βs for candidate munitions items identified in the conceptual site model (CSM) will be used for classification. Entries in existing libraries will be confirmed as representative (i.e. the same caliber, model and configuration) of the munitions items presented in the table by a qualified unexploded ordnance (UXO) Technician. Intrinsic parameters for items listed in the CSM not confirmed to be in the existing library will be derived from test measurements prior to the start of the classification process if the items are available for test or the closest available item in size and shape will be used as a surrogate.

In addition to the comparison using the site-specific library, the cued polarizabilities will also be compared to a comprehensive library containing items not expected at the site. A sample of those cued targets that produce a high confidence match will be requested as training data. Representative signatures of any training targets that are identified as TOI will be added to the site-specific library.

3.6.4. Threshold Selection and Final Classification

The UX-Analyze tool to perform classification and ranking of targets allows for user input of selected thresholds and applies classification expressions to rank the targets. The classification expressions contain the logic for sorting the sources into a ranked target list. The initial expressions are provided with the UX-Analyze module and can be customized to best suit the project goals. Initial threshold selection values will be defined during preliminary library matching and cluster analysis and will incorporate system performance observed at the test pit and IVS. The stop dig point will be verified by ensuring the defined threshold encapsulates all QC seeds and TOI revealed during the training data verification.

All sources output from the N-dipole solver will be consolidated into a ranked list. For each flag position, the best decision statistic is used from all the sources to rank and classify the target list. If multiple sources at a flag position produce a decision statistic above the analyst's threshold, they are all kept if they are at unique locations. Classification decision plots displaying a size/decay plot, library match, decision rank plot, cluster plot and target parameters along with the target features database will be reviewed with the interactive classification tool by the data processor to refine the sorting of the prioritized target list. Further refinement of the analysis process may occur at this time, and details of the classification process will be documented in a target classification report.

3.6.5. Generate Prioritized Target List

A preliminary ranked list containing all anomalies will be delivered to the QC Geophysicist to determine if all relevant MQOs (including QC seed classification) have been met. Every investigated target will be included on the prioritized list and will be classified as TOI, non-TOI, or can't analyze and sorted based on their likelihood to be TOI. All targets in the can't analyze and TOI categories will be selected for intrusive investigation.

After the QC Geophysicist has performed all relevant checks and has provided feedback to the data processor, a final review of the ranked list will be performed to generate the prioritized target list.

The target classification report will include descriptions and values for all thresholds and classification expressions used to generate interim and final ranked target lists.

4. Data Management

4.1. Data inputs

The data inputs required for performing a cued advanced analysis data processing are:

- a list of target anomalies including identifier (ID) and position (X, Y)
- a list of Background locations (ID, X, Y)
- a list of IVS locations (ID, X, Y)
- advanced EMI sensor measurement data including those for target anomalies, daily IVS, backgrounds, and function tests
- digital field notes for all data collection activities
- site specific library signatures and/or test stand measurements of intended site specific library items

4.2. Data Outputs

The data outputs of the cued advanced analysis data processing for each delivered survey unit (contiguous subset of the survey site) are:

- QC report including documenting performance relative to QAPP Worksheet #22 for:
    - IVS results
    - function test results
    - background measurements

- target anomaly measurements
- prioritized target list
- target classification report
- revised validation plan
- target measurement data, background measurement data, and target feature databases
- supporting documents for classification (PDF images)

5. Quality Control

The QC checklist to this SOP (ANJV QC application) will be filled out and delivered as part of the reporting requirement for this SOP.

The measurement quality objectives (MQOs) for cued target measurements are presented in Worksheet #22 of the QAPP. Performance relative to the MQOs will be assessed during the processing of the collected data. Cued data will not be used to classify targets until these MQOs are met or until the project team agrees on modifications to these MQOs.

6. Reporting

Reporting of the activities associated with this SOP will consist of:

- a QC Report detailing the system performance against the MQOs identified on QAPP Worksheet #22 (including MQOs for daily IVS and Function Test performance as well as for individual measurement metrics).
- a Classification Report detailing specific approach to classification including final library make-up, cut-off threshold, cluster analysis approach and results, and feature space analysis approach and results.

7. Revision History

03-13-17 Added ‘Revision History’ section to SOP.

01-03-18 Revised text to be suitable for advanced sensors in general and not specific to the TEMTADS and MetalMapper.

01-05-18 Added ANJV logo

AcornSI and NAEVA JV
ADVANCED GEOPHYSICAL CLASSIFICATION

STANDARD OPERATING PROCEDURE 9

Recovered Item Verification

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when comparing the results of an intrusive investigation against the target parameters resulting from analysis of advanced sensor data.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in background correction:

- Project Geophysicist
- QC Geophysicist

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Oasis montaj with the UX-Analyze module activated
- results of the intrusive investigation to include recovery depths, photographs and descriptions

3. Procedures and Guidelines

Each item recovered during the intrusive investigation of an anomaly should be compared to the results of the data analysis. Specific parameters to compare include burial depth, rough size, and item shape. Any significant deviations will require a re-examination of the anomaly and/or a re-analysis of the advanced sensor data.

3.1. Compare Recovered Item(s) Against Predictions

In the case where only a single item is predicted to be the source of the anomaly, this comparison is relatively straightforward.

1. Compare predicted depth to actual burial depth. These should agree to within 10 cm.
2. Compare recovered item size to predicted size band. The project database in Oasis montaj will contain a predicted size for the item within three bands. Items defined as small will be the size of a 37-mm projectile and smaller, items defined as medium will be larger than a 37-mm projectile and smaller than a 105-mm projectile, and items defined as large will be the size of a 105-mm projectile and larger.
3. Compare the shape of the recovered item to the predicted shape. The predicted shape is inferred from the polarizability decay curves in the project database. Three examples of

symmetric (or near-symmetric) items are shown in Figure 1. If all three curves are different, then the object is predicted to be non-symmetric.

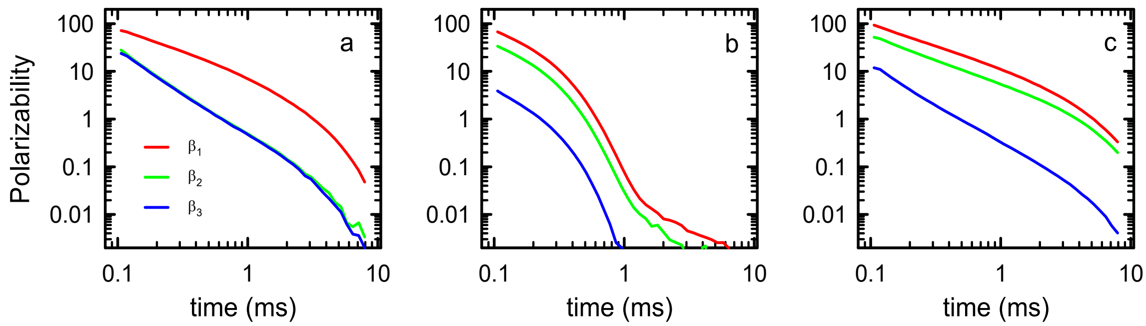


Figure 1. Examples of the polarizability decay curves for a variety of symmetric (or near-symmetric) objects. The curves in plot (a) depict a cylindrical object with one large response and two smaller, but equal responses. In addition, the polarizabilities decay slowly indicating a thick-walled object. The curves in (b) result from a plate-like object with two large and nearly equal, responses and one smaller response. These polarizabilities decay quickly indicating a thin-walled object. The object in plot (c) is also plate-like but thicker walled as indicated by the slowly decaying polarizabilities.

If the analysis indicates the anomaly results from multiple items, then a comparison will be required for each item recovered.

3.2. Resolution of a Mismatch

There are two common causes for a mismatch between the recovered object and the analysis predictions. The resolution of these cases is straightforward.

1. A small item is recovered from a shallow depth when the prediction is for a larger item more deeply buried. This often results from a failure of the intrusive crew to clear the hole after recovering a shallow frag item.
2. A small item (or no item) is recovered when the prediction is for a very deeply buried large item. This often results when the anomaly resulted from geologic interference. In attempting to reproduce the measured anomaly, the inversion routine is driven toward a very deep large anomaly.

Any other mismatch between prediction and observations will require an examination of the anomaly location or the analysis or both.

4. Data Management

The following sections describe the data that is needed to perform this SOP.

4.1. Input Data Required

The analysis predictions for depth, size, and shape are contained in the project database in Oasis montaj. The parameters of the recovered items are contained in the intrusive results file.

4.2. Output Data

The resolution of any mismatches between the recovered items and analysis predictions will be documented in an Analysis Verification Report to be submitted by the Project Geophysicist.

5. Quality Control

QC consists of performing the inspections on the Recovered Object Verification Checklist (ANJV QC application). This checklist will be completed by the QC Geophysicist and will be observed by the Project geophysicist who will document the implementation of this SOP in the Geophysics Daily QC Report.

The measurement quality objectives (MQOs) are presented in Worksheet #22 of the QAPP.

6. Reporting

Achievement of the Recovered Object Verification MQOs (see QAPP Worksheet # 22) will be documented by the QC Geophysicist by completion of the QC Checklist in Attachment 1 to this SOP.

7. Revision History

3-13-17 Added ‘Revision History’ section to SOP.

1-5-18 Added ANJV logo

STANDARD OPERATING PROCEDURE 10
Validate Classification Process

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when validating the classification process at the completion of a munitions response. The items dug as TOI have validated the ability of the analyst to correctly classify UXO. This procedure is intended to validate the remaining question: was the analyst able to classify non-TOI correctly. To accomplish this validation, the site team will randomly select a number of anomalies classified as due to non-TOI. The analyst will provide the rationale for classifying these items as non-TOI. The items will be excavated and compared to this rationale.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in background correction:

- Project Geophysicist
- QC Geophysicist
- Data Analyst

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Oasis montaj with the UX-Analyze module activated
- results of the intrusive investigation for the validation items to include recovery depths, photographs and descriptions

3. Procedures and Guidelines

The site team will choose a number of items (to be specified in Worksheet # 22 of the QAPP) for validation digs. In many cases, these items will be chosen randomly from the list of anomalies classified as non-TOI. It is possible that some of these validation items may be chosen based on particular characteristics of the item (e.g. a large "cluster" of items with similar polarizabilities that have not been investigated). This list will be provided to the analyst and intrusive team.

3.1. Provide Rationale for Classification Decision

For each item on the validation list, the analyst will provide a brief rationale for the classification decision. In many cases, this will be a simple statement such as "item too small to be TOI," "thin-walled plate like object," or "item recognized as a baseplate." If a more detailed narrative is required, the analyst will provide it.

3.2. Excavate the Anomaly

In parallel with the analyst's work, the intrusive team will return to the listed anomalies and excavate them using standard procedures. The excavated items should be saved for examination by the QC geophysicist. If this is not possible, a series of photographs should be recorded.

3.3. Compare Excavated Item to Prediction

Each excavated item will be compared by the QC geophysicist to the prediction generated by the analyst. Each recovered item should qualitatively support the rationale provided for the classification decision. For a single-source inversion this comparison is straightforward. For a multi-source inversion with several realizations, the comparison may be more involved but the principle remains the same.

In the unlikely event a TOI is recovered during this validation effort, all work should stop and the site manager notified of this serious systemic failure. Otherwise, the QC Geophysicist will prepare a Validation Report documenting the analyst's predictions and the actual recoveries from the intrusive investigation.

4. Data Management

The following sections describe the data that is needed to perform this SOP.

4.1. Input Data Required

The list of validation anomalies chosen by the site team is the input to this SOP.

4.2. Output Data

The comparison of the recovered items and analysis predictions will be documented in a Validation Report to be submitted by the Project Geophysicist.

5. Quality Control

QC consists of performing the inspections on the Validation Checklist (ANJV QC application). This checklist will be completed by the QC Geophysicist and will be observed by the Project geophysicist who will document the implementation of this SOP in the Geophysics Daily QC Report.

The measurement quality objectives (MQOs) for this SOP are presented in Worksheet #22 of the QAPP.

6. Reporting

Achievement of the Recovered Object Verification MQOs (see the MQOs Worksheet #22) will be documented by the QC Geophysicist by completion of the QC Checklist in Attachment 1 to this SOP.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

1-5-18 Added ANJV logo

STANDARD OPERATING PROCEDURE 11GPS
Assemble the Trimble R8 RTK GPS

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when assembling the Trimble R8 Real Time Kinematic (RTK) Global Positioning System (GPS) and verifying that all components are correctly assembled, operating normally, and can acquire data of sufficient quality.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the RTK GPS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- MetalMapper or TEMTADS 2x2 sensor coupled with a Trimble R8 RTK GPS survey system and Inertial Measurement Unit (IMU) for orientation measurements
- Method to measure the height of GPS base antenna

3. Procedures and Guidelines

This Trimble R8 system operates with a base station and rover units. To overcome atmospheric distortion of satellite signals the systems utilize a base station receiver and antenna affixed to a known monument tethered to a TDL 450 radio providing real time corrections to the rover receiver via 1 Hertz (Hz) interval. The R8 base station calculates the specific distortion and the rover unit receives these measurements, 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.

3.1. Assemble the RTK GPS

All instruments will be assembled and calibrated (where required) as specified in their User Manuals. Accurate positional data requires the Trimble base station be anchored on a fixed monument, either provided from professionally surveyed positions or established through the collection of raw observables over user defined time increments and corrected in conjunction with established Continuously Operated Reference Station (CORS) data. A static National Spatial Reference System

(NSRS) position requires a minimum of 2 hours of raw observables; a rapid static position can be obtained in only 15 minutes but are subject to much more aggressive algorithms and location availability.

Trimble R8 and TDL 450 configuration and data storage utilizes the Trimble TSC2 controller operated via a wireless Bluetooth communications port or serial connection to laptop computer or other task specific data logger. The assembly steps are briefly described below:

1. The base station and TDL 450 radio are setup and positioned according to the Trimble R8 manual in areas affording unobstructed views of the sky.
2. The base receiver is securely anchored on a tripod, leveled via bubble sight, and accurately positioned over the known base ground mark with the center leg, plum bob, or borehole sight.
3. The base height is calculated either based on the fixed tripod's known measurements or manually measured from the benchmark to the antenna.
4. A rechargeable removable battery provides up to 5 hours of receive/output availability with additional external power input through the "Y" 7-pin data/power cable sourced from Trimble battery packs. The TDL 450 receives corrections to be transmitted through the "Y" 7-pin radio connector port attached to the base receiver and is externally powered by a 12V deep discharge deep cycle battery, ensuring operation for the duration of the field day.
5. User can select low power output (2W) or up to 35W for higher power and increased range; lower settings preserve battery life. The TDL 450 can be configured to broadcast on user-selected bands from 450 MHz – 470 MHz dependent on site conditions and FCC licensing.
6. The rover unit receives power from an interchangeable, rechargeable, removable Lithium-Ion battery and receives corrections via the internal integrated 450 MHz data link radio. The rover can be mounted on a rigid field staff for surveying activities controlled through the Trimble TSC2 controller or configured to output user selected positional data streams for capture on field data loggers such as during Digital Geophysical Mapping (DGM) activities.

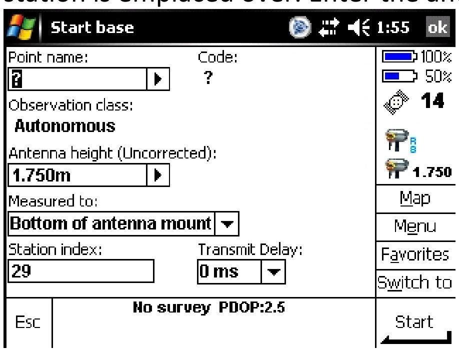
3.2. Turn On and Configure the GPS Base Receiver

The following steps are followed to Start the GPS base receiver.

1. Turn on the Trimble base receiver and TDL 450 Radio by depressing the labeled power buttons. Green indicator light will flash then remain lit to indicate power. The power LED on the Trimble 450 indicates power when lit. Both the Trimble and TDL 450 power indicators will flash to indicate low power supply when applicable. Turn on the Trimble TSC2 controller and start the Survey Controller program. Connect to the R8 base receiver via the Bluetooth connection port accessed under Configuration on the main menu. Alternatively, a cable can be connected to the appropriate port on the TSC2.
2. From the main menu select Configuration, Survey styles, RTK and select Base options. User is prompted to select the Base options specific for the base equipment and job site conditions on three separate sub menus. Enabling Tracking of L2e, GPS L2C, and GLONASS in conjunction with an R8 rover unit will allow the maximum number of corrections to be received and provide the highest accuracy for field activities under the most physical limitations, i.e. canopy cover or other obstructions.
3. From the RTK submenu under Survey styles select Base Radio and under Type select Trimble TDL 450. Select Connect to configure Base Radio settings and follow onscreen directions if

prompted. Note that most TDL 450 functions and configuration can also be accessed via the LED menu located on the front of the unit at any time. Note that Frequency should be selected based on known clear channels that will not interfere with other base systems in the vicinity and that are unlikely to be utilized by other activities that would conflict with the TDL 450's ability to transmit a strong clear signal.

4. From Survey select RTK… and Start base receiver. Point Name refers to the monument the base station is emplaced over. Enter the antenna height into the appropriate field.



The Tx LED on the Trimble TDL 450 will flash approximately once per second indicating signal transmission. If the Rx LED is blinking or on continuously, a source of interference may be affecting the radio's ability send data, and a new transmission frequency may be required.

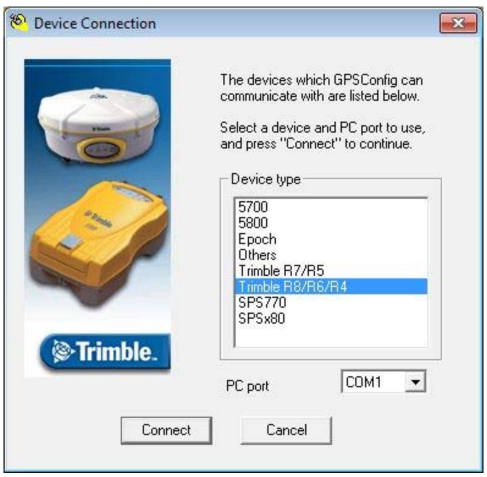
3.3. Turn On and Configure the GPS Rover Receiver

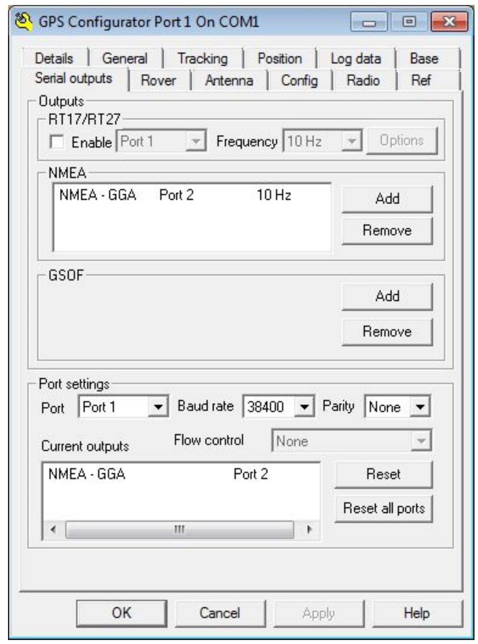
The following steps are followed to Start and configure the GPS rover receiver.

1. Power on the rover unit by depressing the green power indicator on the unit face, the temporary green flashing LED to steady indicates power, and will resume flashing upon battery depletion. Connect the TSC2 to the Trimble rover receiver via the Bluetooth or cable. All main menu data will reflect settings received from the rover unit.
2. From the main menu select Configuration, Survey styles, RTK, and select Rover options. Note that Antenna Type is set to the corresponding antenna (with the R8 the antenna is set to R8 GNSS/SPS88x) and Tracking enables L2e, GPS L2C, and GLONASS, identical to the R8 base receiver settings. Select the same satellite types and settings as were selected on the base receiver.
3. From the RTK submenu under Survey styles select Rover radio. Connect to the rover radio ensuring that Type is Trimble internal and Method is Trimble 450/900. Note that Frequency must be identical to the frequency selected for the base and TDL 450 radio to receive the proper corrections. Base radio mode is set to TT450s at 8000 bps for use with the R8. The Trimble base receiver and rover receiver must have matching protocol and baud rates.
4. From Survey select RTK… and Start Survey. Survey Controller will initiate a new survey and display the quality at the bottom of the screen. It is important to ensure that the rover has achieved a Fixed position before commencing any DGM or surveying activities as this will create the highest quality of location data. Autonomous mode or Float indicates that the rover is not receiving enough corrections or clear radio transmission and should be corrected before proceeding, often by moving out from under canopy or away from obstructions that may limit the receiver's view of the sky. There is also the possibility that the base receiver has not been

placed in a clear position and is not receiving corrections required to initiate a fix. The TSC2 controller will audibly and visibly indicate poor PDOP, satellite reception, or radio link.

5. Software utilized for the collection of geophysical data requires National Marine Electronics Association (NMEA) GGA global positioning system fix data. The Trimble rover receiver must be configured to ensure the serial output is capturing the correct positioning data for DGM. Trimble's GPS Configurator or Configuration Toolbox software allows a serial connection through the serial port on a laptop computer to input the desired settings. From the start screen select the Trimble corresponding receiver from the list and appropriate COM for the rover receiver.





6. Select the Serial outputs tab. The user must select Add from the NMEA Outputs window then select Type, Port, and Frequency from the Add NMEA outputs box. Refer to the specific geophysical instrument User Manual for recommended settings. The user also has the ability to Remove previously store outputs by selecting Remove from the Outputs on the Serial outputs tab. Select Apply to store the settings before continuing or exiting.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the assembly and operation instructions for the Trimble R8 RTK GPS and the coordinates of a fixed monument to be used as the base station location.

4.2. Output Data

Errors in the GPS system are monitored at the fixed (and known) base station, and a series of position corrections are computed. The messages are sent through a radio link to the rover receiver, where they are used to correct the real-time positions of the rover. The RTK GPS data will be saved as part of the MetalMapper or TEMTADS data over the IVS and survey area. Also, the base height used during setup will be recorded.

5. Quality Control

This procedure is performed throughout the project. Performance of the required QC checks will be documented by the Field or Project Geophysicist (ANJV QC application). The QC Geophysicist will verify and document successful completion of the procedures in the Geophysics Daily QC Report.

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly and configuration instructions have been followed. The IVS data (see SOP 2) will be used to observe the location accuracy of the predicted IVS items. Should an issue be detected (such as a data trend indicating a MQO limit is being approached) or a MQO is not met, a comprehensive root-cause analysis will be performed and a corrective action determined.

6. Reporting

Achievement of the RTK GPS Assembly MQO will be documented by the Field or Project Geophysicist by completion of the QC Checklist in Attachment 1 to this SOP and will be verified by the QC Geophysicist.

The QC Checklist will be completed by the Field or Project Geophysicist each time the GPS base station is assembled during the production survey and a copy of these completed checklists will be included with the Classification Project Report at the end of the project.

The field geophysicist/technician will measure the location of a known point and compare the result to the actual location (ground truth). Offsets less than 10 cm will satisfy the MQO. This check will be performed daily after starting the base station, storing the recorded point identified with the date in the field log.

7. Revision History

3-13-17 Added 'Revision History' section to SOP.

1-5-18 Added ANJV logo

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STANDARD OPERATING PROCEDURE 11GPS
Assemble the Trimble R8 RTK GPS

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when assembling the Trimble R8 Real Time Kinematic (RTK) Global Positioning System (GPS) and verifying that all components are correctly assembled, operating normally, and can acquire data of sufficient quality.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the RTK GPS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- MetalMapper or TEMTADS 2x2 sensor coupled with a Trimble R8 RTK GPS survey system and Inertial Measurement Unit (IMU) for orientation measurements
- Method to measure the height of GPS base antenna

3. Procedures and Guidelines

This Trimble R8 system operates with a base station and rover units. To overcome atmospheric distortion of satellite signals the systems utilize a base station receiver and antenna affixed to a known monument tethered to a TDL 450 radio providing real time corrections to the rover receiver via 1 Hertz (Hz) interval. The R8 base station calculates the specific distortion and the rover unit receives these measurements, 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.

3.1. Assemble the RTK GPS

All instruments will be assembled and calibrated (where required) as specified in their User Manuals. Accurate positional data requires the Trimble base station be anchored on a fixed monument, either provided from professionally surveyed positions or established through the collection of raw observables over user defined time increments and corrected in conjunction with established Continuously Operated Reference Station (CORS) data. A static National Spatial Reference System

(NSRS) position requires a minimum of 2 hours of raw observables; a rapid static position can be obtained in only 15 minutes but are subject to much more aggressive algorithms and location availability.

Trimble R8 and TDL 450 configuration and data storage utilizes the Trimble TSC2 controller operated via a wireless Bluetooth communications port or serial connection to laptop computer or other task specific data logger. The assembly steps are briefly described below:

1. The base station and TDL 450 radio are setup and positioned according to the Trimble R8 manual in areas affording unobstructed views of the sky.
2. The base receiver is securely anchored on a tripod, leveled via bubble sight, and accurately positioned over the known base ground mark with the center leg, plum bob, or borehole sight.
3. The base height is calculated either based on the fixed tripod's known measurements or manually measured from the benchmark to the antenna.
4. A rechargeable removable battery provides up to 5 hours of receive/output availability with additional external power input through the "Y" 7-pin data/power cable sourced from Trimble battery packs. The TDL 450 receives corrections to be transmitted through the "Y" 7-pin radio connector port attached to the base receiver and is externally powered by a 12V deep discharge deep cycle battery, ensuring operation for the duration of the field day.
5. User can select low power output (2W) or up to 35W for higher power and increased range; lower settings preserve battery life. The TDL 450 can be configured to broadcast on user-selected bands from 450 MHz – 470 MHz dependent on site conditions and FCC licensing.
6. The rover unit receives power from an interchangeable, rechargeable, removable Lithium-Ion battery and receives corrections via the internal integrated 450 MHz data link radio. The rover can be mounted on a rigid field staff for surveying activities controlled through the Trimble TSC2 controller or configured to output user selected positional data streams for capture on field data loggers such as during Digital Geophysical Mapping (DGM) activities.

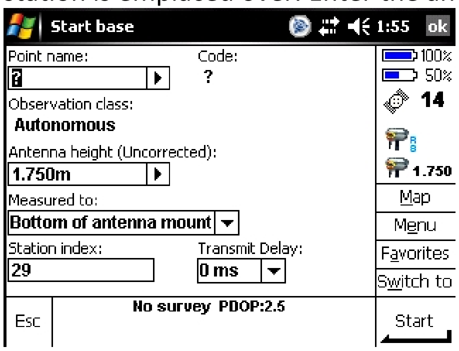
3.2. Turn On and Configure the GPS Base Receiver

The following steps are followed to Start the GPS base receiver.

1. Turn on the Trimble base receiver and TDL 450 Radio by depressing the labeled power buttons. Green indicator light will flash then remain lit to indicate power. The power LED on the Trimble 450 indicates power when lit. Both the Trimble and TDL 450 power indicators will flash to indicate low power supply when applicable. Turn on the Trimble TSC2 controller and start the Survey Controller program. Connect to the R8 base receiver via the Bluetooth connection port accessed under Configuration on the main menu. Alternatively, a cable can be connected to the appropriate port on the TSC2.
2. From the main menu select Configuration, Survey styles, RTK and select Base options. User is prompted to select the Base options specific for the base equipment and job site conditions on three separate sub menus. Enabling Tracking of L2e, GPS L2C, and GLONASS in conjunction with an R8 rover unit will allow the maximum number of corrections to be received and provide the highest accuracy for field activities under the most physical limitations, i.e. canopy cover or other obstructions.
3. From the RTK submenu under Survey styles select Base Radio and under Type select Trimble TDL 450. Select Connect to configure Base Radio settings and follow onscreen directions if

prompted. Note that most TDL 450 functions and configuration can also be accessed via the LED menu located on the front of the unit at any time. Note that Frequency should be selected based on known clear channels that will not interfere with other base systems in the vicinity and that are unlikely to be utilized by other activities that would conflict with the TDL 450's ability to transmit a strong clear signal.

4. From Survey select RTK… and Start base receiver. Point Name refers to the monument the base station is emplaced over. Enter the antenna height into the appropriate field.



The Tx LED on the Trimble TDL 450 will flash approximately once per second indicating signal transmission. If the Rx LED is blinking or on continuously, a source of interference may be affecting the radio's ability send data, and a new transmission frequency may be required.

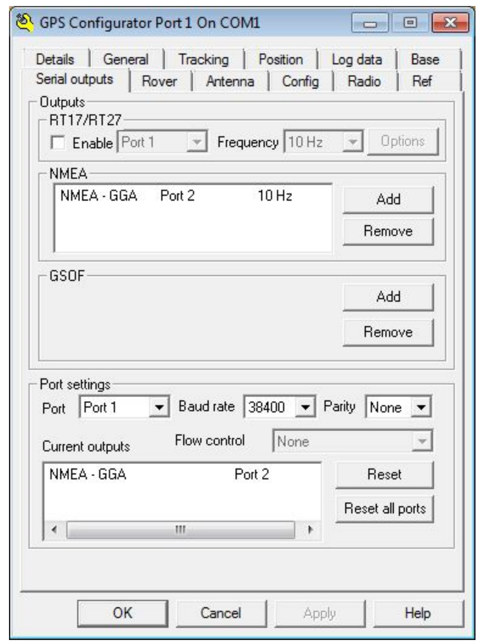
3.3. Turn On and Configure the GPS Rover Receiver

The following steps are followed to Start and configure the GPS rover receiver.

1. Power on the rover unit by depressing the green power indicator on the unit face, the temporary green flashing LED to steady indicates power, and will resume flashing upon battery depletion. Connect the TSC2 to the Trimble rover receiver via the Bluetooth or cable. All main menu data will reflect settings received from the rover unit.
2. From the main menu select Configuration, Survey styles, RTK, and select Rover options. Note that Antenna Type is set to the corresponding antenna (with the R8 the antenna is set to R8 GNSS/SPS88x) and Tracking enables L2e, GPS L2C, and GLONASS, identical to the R8 base receiver settings. Select the same satellite types and settings as were selected on the base receiver.
3. From the RTK submenu under Survey styles select Rover radio. Connect to the rover radio ensuring that Type is Trimble internal and Method is Trimble 450/900. Note that Frequency must be identical to the frequency selected for the base and TDL 450 radio to receive the proper corrections. Base radio mode is set to TT450s at 8000 bps for use with the R8. The Trimble base receiver and rover receiver must have matching protocol and baud rates.
4. From Survey select RTK… and Start Survey. Survey Controller will initiate a new survey and display the quality at the bottom of the screen. It is important to ensure that the rover has achieved a Fixed position before commencing any DGM or surveying activities as this will create the highest quality of location data. Autonomous mode or Float indicates that the rover is not receiving enough corrections or clear radio transmission and should be corrected before proceeding, often by moving out from under canopy or away from obstructions that may limit the receiver's view of the sky. There is also the possibility that the base receiver has not been

placed in a clear position and is not receiving corrections required to initiate a fix. The TSC2 controller will audibly and visibly indicate poor PDOP, satellite reception, or radio link.

5. Software utilized for the collection of geophysical data requires National Marine Electronics Association (NMEA) GGA global positioning system fix data. The Trimble rover receiver must be configured to ensure the serial output is capturing the correct positioning data for DGM. Trimble's GPS Configurator or Configuration Toolbox software allows a serial connection through the serial port on a laptop computer to input the desired settings. From the start screen select the Trimble corresponding receiver from the list and appropriate COM for the rover receiver.



6. Select the Serial outputs tab. The user must select Add from the NMEA Outputs window then select Type, Port, and Frequency from the Add NMEA outputs box. Refer to the specific geophysical instrument User Manual for recommended settings. The user also has the ability to Remove previously store outputs by selecting Remove from the Outputs on the Serial outputs tab. Select Apply to store the settings before continuing or exiting.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

Input data consists of the assembly and operation instructions for the Trimble R8 RTK GPS and the coordinates of a fixed monument to be used as the base station location.

4.2. Output Data

Errors in the GPS system are monitored at the fixed (and known) base station, and a series of position corrections are computed. The messages are sent through a radio link to the rover receiver, where they are used to correct the real-time positions of the rover. The RTK GPS data will be saved as part of the MetalMapper or TEMTADS data over the IVS and survey area. Also, the base height used during setup will be recorded.

5. Quality Control

This procedure is performed throughout the project. Performance of the required QC checks will be documented by the Field or Project Geophysicist (ANJV QC application). The QC Geophysicist will verify and document successful completion of the procedures in the Geophysics Daily QC Report.

The measurement quality objective (MQO) (QAPP Worksheet #22) for this SOP is verification that the assembly and configuration instructions have been followed. The IVS data (see SOP 2) will be used to observe the location accuracy of the predicted IVS items. Should an issue be detected (such as a data trend indicating a MQO limit is being approached) or a MQO is not met, a comprehensive root-cause analysis will be performed and a corrective action determined.

6. Reporting

Achievement of the RTK GPS Assembly MQO will be documented by the Field or Project Geophysicist by completion of the QC Checklist in Attachment 1 to this SOP and will be verified by the QC Geophysicist.

The QC Checklist will be completed by the Field or Project Geophysicist each time the GPS base station is assembled during the production survey and a copy of these completed checklists will be included with the Classification Project Report at the end of the project.

The field geophysicist/technician will measure the location of a known point and compare the result to the actual location (ground truth). Offsets less than 10 cm will satisfy the MQO. This check will be performed daily after starting the base station, storing the recorded point identified with the date in the field log.

7. Revision History

3-13-17 Added ‘Revision History’ section to SOP.

1-5-18 Added ANJV logo

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STANDARD OPERATING PROCEDURE

Initial Demonstration of Capability (DOC)

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to be employed when conducting individual demonstrations of capability (DOC). The internal DOC shall be performed by all personnel responsible for collecting and analyzing data using an advanced EM sensor for UXO classification.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in conducting the DOC (as required):

- Technical Manager
- Quality Manager
- Project Geophysicist
- Field Geophysicists and Technicians
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the Job descriptions located on the AN JV ISO conformance portal.

The following is a list of required equipment and materials:

- Test site consisting of an IVS lane and a test bed of 5-10 test objects containing a mixture of TOI and non-TOI items
- Test data set consisting of approximately 1 acre of dynamic data and the corresponding cued data. The sources are a mixture of TOI and non-TOI objects at varying depths and orientations.
- Geometrics MetalMapper or TEMTADS sensor coupled with a real-time kinematic Global Positioning System (RTK GPS) or Robotic Total Station (RTS) and Inertial Measurement Unit (IMU) for orientation measurements
- transport vehicle (skid steer, tractor, extended reach forklift) used to move the MetalMapper during data collection
- measuring tape and non-metallic markers (pin flags, stakes, tent pegs, spray paint, etc.) to mark the positions of the test items and the beginning and end of the IVS

Successful completion of the internal DOC is required prior to production fieldwork, and at 2-year intervals thereafter. After completion of the initial Internal DOC, employees will be required to perform 40hours of supervised (support) work before becoming the lead field geophysicist/technician, or data analyst.

3. Procedures and Guidelines

The personnel required to perform the internal DOC can be divided into 3 groups:

- Field geophysicist and technicians
- Data processor and analyst
- Project geophysicist

The field geophysicist and technicians shall demonstrate the following minimum skills:

- Instrument assembly and operation
- Continuous operation within specifications
- Dynamic operation
- Cued operation

The personnel performing data processing and analysis shall demonstrate the following minimum skills:

- Quality control checks of field data (unknown targets and background)
- Background correction
- Source selection (dynamic survey only)
- Data inversion
- Classification
- Documenting results via standard data plots

The project geophysicist shall demonstrate all of the minimum skills for the field geophysicist and data processor described above. In addition, the project geophysicist shall have documented experience in the following:

- Geophysical survey design and management
- Data usability assessment

3.1. Field Personnel

All field personnel will be required to successfully perform the following tasks as part of the initial DOC. All referenced SOPs are located on the AN JV ISO conformance portal in the subcategory SOP:

- Assemble the RTK GPS using the sensor specific SOP (for example, 'Assemble the RTK GPS Positioning System') and verify that all components are operating normally and capable of acquiring data of sufficient quality.
- Assemble the sensor using the sensor specific SOP (for example, 'Assemble the MetalMapper System' or 'Assemble the TEMTADS 2x2 System') and verify that all components are operating normally and capable of acquiring data of sufficient quality. This includes performing a sensor function test, IMU orientation test, and GPS operation test.
- Test the sensor and system at the instrument verification strip (IVS) in accordance with the procedures in the SOP – "Sensor and System IVS". Collect data over the IVS in dynamic and cued modes of operation.

- Perform a dynamic survey over the test bed in accordance with the sensor specific SOP (for example, 'Perform Dynamic Survey with MetalMapper' or 'Perform Dynamic Survey with TEMTADS 2x2').
- Collect static background measurements at a suitable location in the test bed in accordance with the SOP – "Collect Static Background Measurements". This includes collecting data to verify if a location is a suitable candidate as a background location.
- Collect cued measurements over the objects in the test bed in accordance to the SOP – "Collect Cued Measurements". This include performing a field inversion and re-positioning the sensor if deemed necessary by the inversion results.

3.2. Data processor

All personnel performing data processing and analysis will be required to successfully perform the following tasks as part of the initial DOC. All referenced SOPs are located on the AN JV ISO conformance portal in the subcategory SOP:

- Process and assess data collected during the sensor assembly and IVS test. Details on the specific tasks required can be found in the "Assemble sensor" SOP and the "Sensor and System IVS" SOP.
- Process the dynamic data collected over the test bed in accordance with the sensor specific SOP (for example, 'Process Dynamic MetalMapper Data' or 'Process Dynamic TEMTADS 2x2 Data'). As part of the data QC, the Function test measurements and daily IVS measurements shall be processed and assessed relative to MQOs presented in Worksheet #22 of the QAAP.
- Process the cued data collected over the test bed in accordance with the SOP – "Process Cued Data". These tasks include data import and QC, data positioning and leveling, target parameter extraction (inversion), and target classification. As part of the data QC tasks, the Function test measurements and daily IVS measurements shall be processed and assessed relative to MQOs presented in Worksheet #22 of the QAAP.
- Validate the classification process in accordance with the SOP – "Validate Classification". The main task is to determine if the analyst accurately classify non-TOI correctly. This is done by comparing the ground truth information to the analyst's rationale for classifying an item as non-TOI.

3.3. Project geophysicist

The project geophysicist will be required to successfully perform all the tasks detailed above for field personnel and data processors as part of the initial DOC. In addition, the project geophysicist shall have documented experience in the following: 1) geophysical survey design and management and 2) data usability assessment.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Input Data Required

The SOPs that are referenced and required to perform the tasks listed in Section 3. Within each of these individual SOPs are details documenting the input data requirements to perform the individual tasks. The aggregate of the input data within each individual SOP constitutes the input data required to perform this SOP.

4.2. Output Data

Within each of the referenced individual SOPs are details documenting the output data that results from performing the individual tasks listed in Section 3. The aggregate of the output data within each individual SOP constitutes the output data of this SOP.

5. Quality Control

Specific details on the QC of the tasks listed in Section 3 are found in each of the referenced SOPs. Overall QC of this SOP consists of performing the inspections on the Demonstration of Capabilities Quality Control Checklist that is included as Attachments 1-3 to this SOP. These checklists will be completed by the Project Geophysicist and Technical Manager and results of the SOP will be documented in the Employee Matrix (Training Record) located on the AN JV ISO conformance portal.

6. Reporting

A Field Geophysicist Trainer will evaluate and approve records documenting satisfactory completion of the internal DOC by field personnel and personnel performing data processing and analysis.

A Technical Manager will evaluate and approve records documenting satisfactory completion of the internal DOC by the project geophysicist. Additionally, a technical manager may sign records documenting satisfactory completion of the internal DOC by field personnel and data processors, if the project geophysicist is not available.

7. Revision History

3-13-17 Added ‘Revision History’ section to SOP.

1-5-18 Generalized section 3 to allow for additional sensor types, and clarified who evaluates and approves of internal DOC’s (section 6).

SOP 12

Attachment 1 DOC - Field Geophysicist/Technician QC Checklist

This checklist is to be completed by the Project Geophysicist during the Demonstration of Capabilities for the Field Geophysicist / Technician.

QC Step	QC Process	Yes/No	Initial of Project Geophysicist
1. Qualifications	Was the RTK-GPS successfully assembled i/a/w the SOP – "Assemble the Trimble GPS"?		
2. Qualifications	Was the MetalMapper or TEMTADS 2x2 sensor successfully assembled i/a/w the respective sensor specific SOP ("Assemble the MetalMapper" or "Assemble the TEMTADS2x2")?		
3. Qualifications	Was the sensor and system successfully tested over the IVS i/a/w the SOP – "Sensor and System IVS"?		
4. Qualifications	Was the dynamic geophysical survey over the test bed successfully performed i/a/w the sensor specific SOP ("Perform Dynamic Survey with MetalMapper" or "Perform Dynamic Survey with TEMTADS 2x2")?		
5. Qualifications	Was the background geophysical survey over the test bed successfully performed i/a/w the SOP - "Collect Static Background Measurements"?		
6. Qualifications	Was the cued geophysical survey over the test bed successfully performed i/a/w the SOP - "Collect Cued Measurements"?		

Trainee: ____________________________Date:___________

Project Geophysicist: ____________________________Date:___________

SOP 12

Attachment 2 DOC – Data Processor QC Checklist

This checklist is to be completed by the Project Geophysicist during the Demonstration of Capabilities for the Data Processor.

QC Step	**QC Process and Guidance Reference**	**Yes/No**	**Initial of Project Geophysicist**
1. Qualifications	For the test data provided, was the dynamic geophysical survey data processed i/a/w the sensor-specific, data-processing SOP ("Process Dynamic MetalMapper Data" or "Process Dynamic TEMTADS 2x2 Data")?		
2. Qualifications	For the test data provided, was the cued geophysical survey data processed i/a/w the SOP - "Process Cued Data"?		
3. Qualifications	For the test data provided, was the classification process validated i/a/w the SOP - "Validate Classification"?		

Trainee: ____________________________Date:___________

Project Geophysicist: ____________________________Date:___________

SOP 12

Attachment 3 DOC - Project Geophysicist QC Checklist

This checklist is to be completed by the Technical Manager during the Demonstration of Capabilities for the Project Geophysicist.

QC Step	QC Process	Yes/ No	Initial of Technical Manager
1. Qualifications	Have all the steps been successfully demonstrated for a Field Geophysicist in Attachment 1 of this SOP?		
2. Qualifications	Have all the steps been successfully demonstrated for a Data processor in Attachment 2 of this SOP?		
3. Qualifications	Has experience in geophysical survey design been documented?		
4. Qualifications	Has experience in data usability assessment been documented?		

Trainee: ____________________________Date:___________

Technical Manager: ____

1. Revision History

3-13-17 Added 'Revision History' section to SOP.

1-5-18 Added ANJV logo

4-9-18 Reworded questions for data processor

7-15-18 Added Trainee line

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STANDARD OPERATING PROCEDURE DGM 01
EM61 Data Collection

1. Purpose and Scope

The purpose of this Standard Operating procedure (SOP) is to identify the means and methods to detail guidelines for EM61 data collection. This document defines the fundamental parameters of data collection using towed Geonics EM61-MK2 systems equipped with Trimble RTK GPS for navigational control and person-portable Geonics EM61-MK2 systems with local fiducial positioning and RTK GPS positioning.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the RTK GPS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Geonics EM61-MK2
- Trimble R8/R7/5700 RTK (Real Time Kinematic) GPS

3. Procedures and Guidelines

The Geonics EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. The Standard EM61-MK2 system consists of two air-cored coils, a digital data recorder, batteries and processing electronics. The EM61-MK2 functions by first having a transmitter that generates a pulsed primary electromagnetic field. This primary electromagnetic field then induces eddy currents in nearby metallic objects. The eddy currents produce a secondary electromagnetic field which then induces a secondary voltage inside the EM61-MK2 receiver coils that is measured at four distinct intervals (time gates) with measurements recorded in milliVolts (mV). The earlier time gates provide enhanced detection of smaller metallic objects while the later time gates provide for the identification of larger, more massive metal objects.

The person-portable system may be operated in two positional modes; RTK-GPS or fiducial mode. The Trimble Real-Time Kinematic (RTK) GPS is a 24-channel dual frequency receiver that uses both L1 and L2 satellite frequencies that can maintain an accuracy of 1.2 inches (in) (3 centimeters (cm)) horizontal and

2 in (5 cm) vertical. This RTK system utilizes a GPS base station (base) that sends positional corrections to the GPS rover(s) via radio link. For configuration with the person-portable system, the rover is set to output a NMEA GGA data string at 1 Hz, which is captured coincident with the EM61-MK2 sensor data in real-time by the Geonics data collection software on an Allegro data recorder. At the end of the day this data is uploaded onto a file sharing site for offsite data processing. Geonics software is used to record the person portable EM61-MK2 sensor data and fiducial data. This data is temporarily stored in an Allegro data recorder during data collection and is then uploaded to a file sharing site for data processing at the end of each day.

The same RTK-GPS system as described above is used with the towed array system. For configuration with the towed array, the rover is set to output a NMEA GGA data string at 1 Hz, which is captured coincident with the EM61-MK2 sensor data in real-time by the Geonics data collection software. This data is temporarily stored in a ruggedized laptop computer with the data being uploaded to a file sharing site for offsite data processing at the end of each day.

3.1. Person Portable Collection

One person operates the EM61-MK2 at a walking pace. Data can be collected on wheels or in tandem mode (the instrument is carried by two operators) with readings triggered at 10 readings/second. Selection of the appropriate method is based primarily on local terrain conditions, with the wheeled configuration favored when using local positioning.

3.1.1. Instrument Setup, Wheel Mode

When the instrument is operated in wheel mode, it is set up according to the Geonics EM61-MK2 Manual. The wheels maintain the bottom coil at a consistent height of 40 cm (15.75 in) above the ground surface and allow the instrument to be towed over the survey area by a single operator. System electronics are mounted on a backpack worn by the operator who also carries the instrument's data logger. To the extent possible, all cables are taped to the instrument to keep them from getting tangled and to minimize cable movement and reduce the potential for snagging vegetation.

3.1.2. Instrument Setup, Tandem Mode

For tandem mode, the EM61-MK2 coils are centered suspended on two 10-ft (3-m) long fiberglass poles. The poles are placed on the top coil and wrapped with webbing that attaches to buckles mounted on the bottom coil. Zip ties are then used to further secure the poles to the outer edges of the top coil. Harnesses made of webbing worn by the operators, as well as flexible plastic rods (typically PVS pin flags) attached to the bottom coil, allow the operators to maintain the same coil height as in the wheeled deployment. System electronics are mounted on a backpack worn by the operator located in the rear of the system who also carries the instrument's data logger. As in the wheel mode configuration, the cables are securely taped prior to the start of data collection to minimize cable movement and to reduce the potential for snagging vegetation.

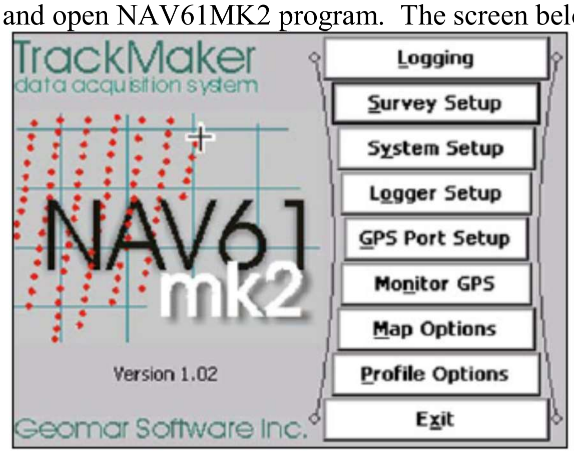
3.1.3. Navigation

Navigation of the person-portable system is accomplished through the integration of RTK GPS equipment or the use of fiducial positional measurements. If RTK-GPS is to be used, the base station is setup on a control point and corrections are sent via radio link to the rover receiver. The rover GPS antenna is mounted over the center of the EM61-MK2 coil and provides real time positional tracking capabilities that is streamed into the same software program as the EM61-MK2 data. 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. Alternating colored markers on the ropes facilitate straight-line profiling and identify locations for the placement of fiducial marks within the recorded data.

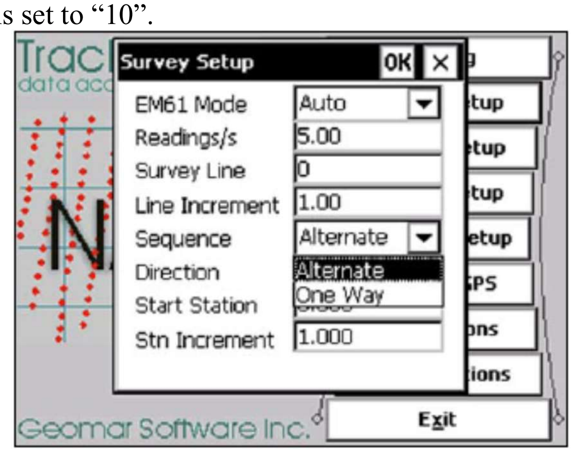
3.1.4. Data collection Steps

The following steps are followed to begin surveying with the EM61-MK2 with RTK GPS positioning:

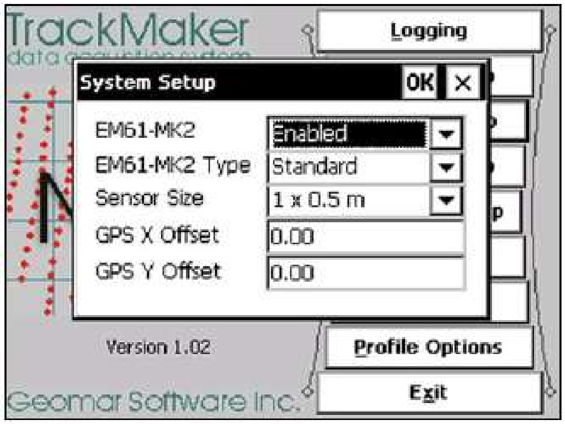
1. Turn on instrument by pushing in the fuse on the top of the console/electronics
2. Allow instrument to warm up for at least 15 minutes
3. Turn on Allegro CX and open NAV61MK2 program. The screen below will be displayed.



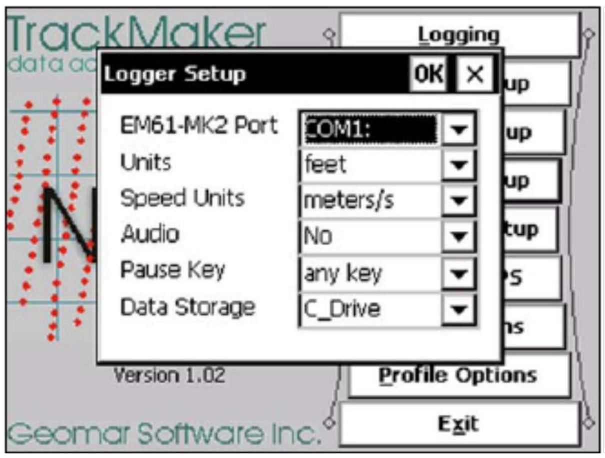
4. Click on “Survey Setup” and specify the below options. For this GPS/RTK Method, the Mode is set to “Auto” and Readings/s is set to “10”.



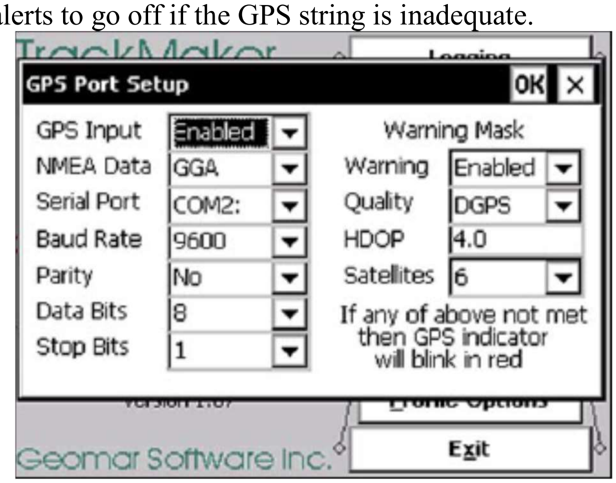
5. Click on “System Setup” and specify the below options. These setting will usually remain the same throughout the project.



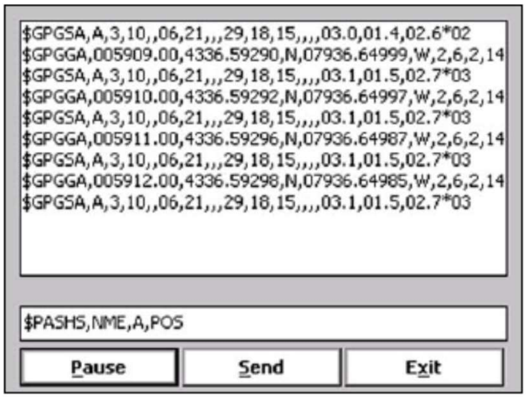
6. Click on “Logger Setup” and specify the below options. These setting will remain the same throughout the project.

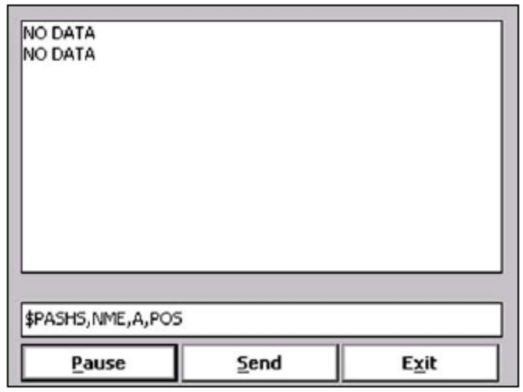


7. Click on “GPS Port Setup” and specify the below options. On the left side of the screen is where parameters can be set for alerts to go off if the GPS string is inadequate.

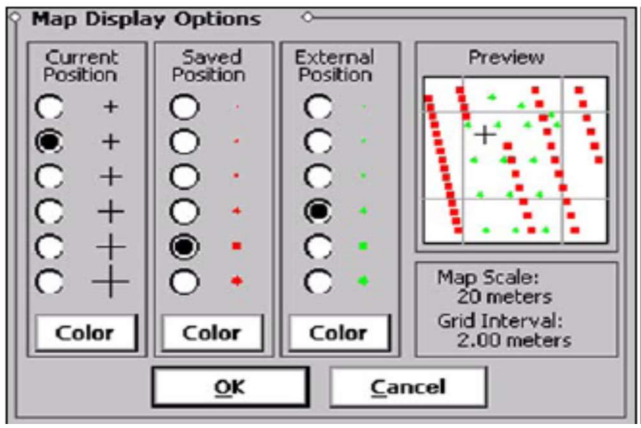


8. Click on “Monitor GPS” and the below window will open. If the NMEA string is coming in correctly, the screen will appear like the one on the left. If there is a problem with the baud rate, “No Data” will appear once a second. If there is nothing coming through “No Data” will flash once every 6 seconds.

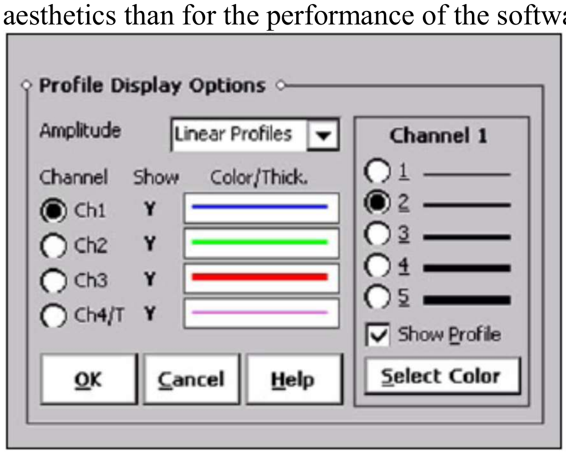




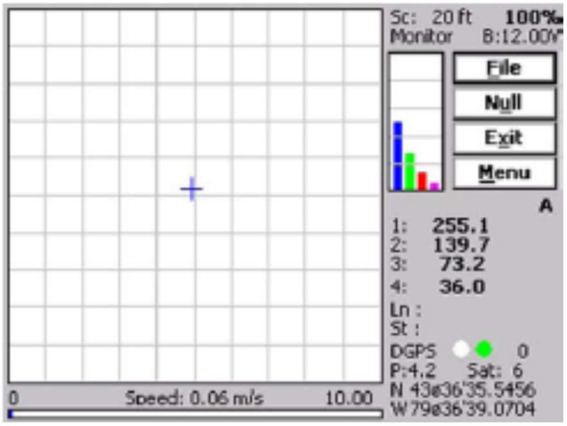
9. Click on “Map Options” and specify the below options. These are more operator preferences for aesthetics than for the performance of the software.

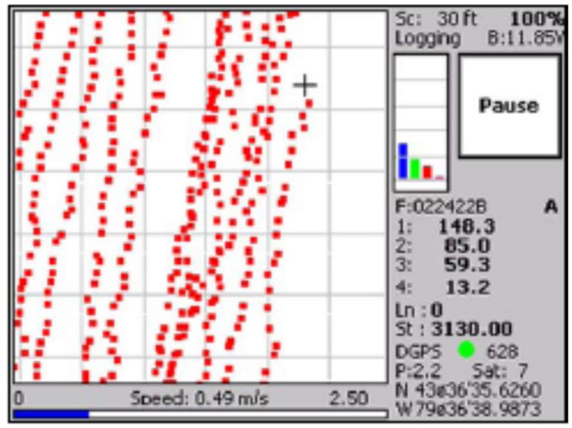


10. Click on “Profile Options” and specify the below options. These are more operator preferences for aesthetics than for the performance of the software.



11. Once all the parameters are set click on the logging screen. The below screens will be displayed. Find a quiet spot and *Null* the instrument, then click on *File* and name your file and save it. Line up on the grid or transect and select *Go*. The software will start logging the readings and a large *Pause* button will appear on the screen. At the end of the line, tap the *Pause* button or hit enter on the keypad.

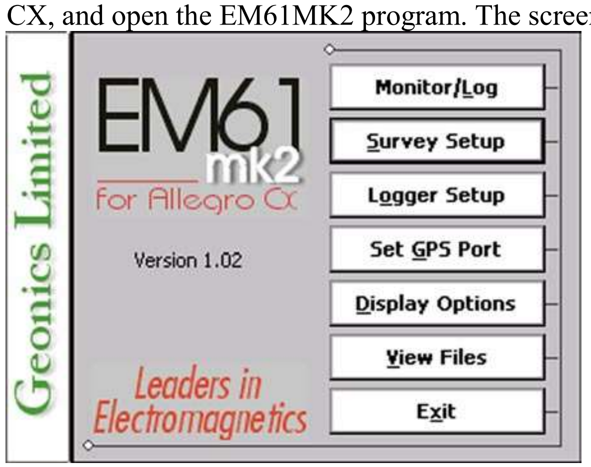




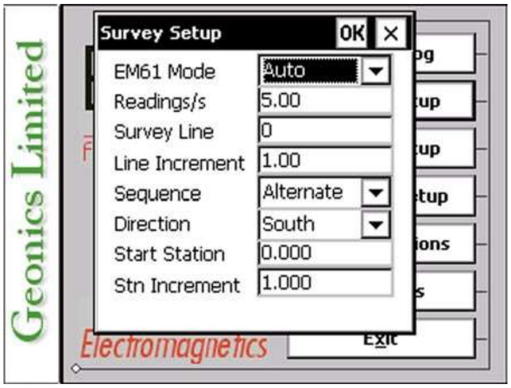
12. On the above screens, both the EM61-MK2 data and the GPS/RTK data are monitored, as well as the data coverage.
13. At the end of the file, the *Exit* button is selected. The file automatically saves at the end of every line.

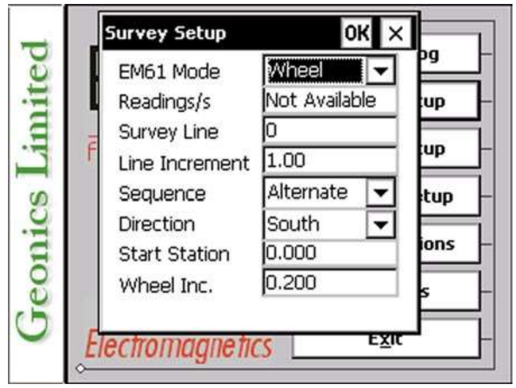
The following steps are followed to begin surveying with the EM61-MK2 with fiducial positioning:

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, and open the EM61MK2 program. The screen below will be displayed.

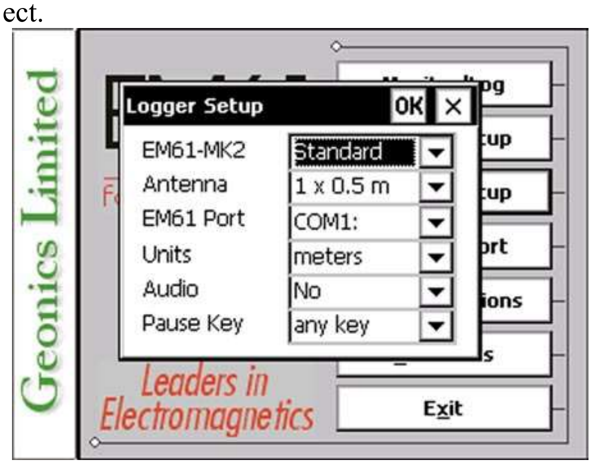


4. Click on "Survey Setup", and specify the following options. Depending on surface conditions, the Mode is set to "Auto" and Readings/s is set to "10" or the Mode is set to "Wheel", Readings/s to "Not Available", and Wheel Inc. to 0.1. The remaining options become important for maintaining positioning.

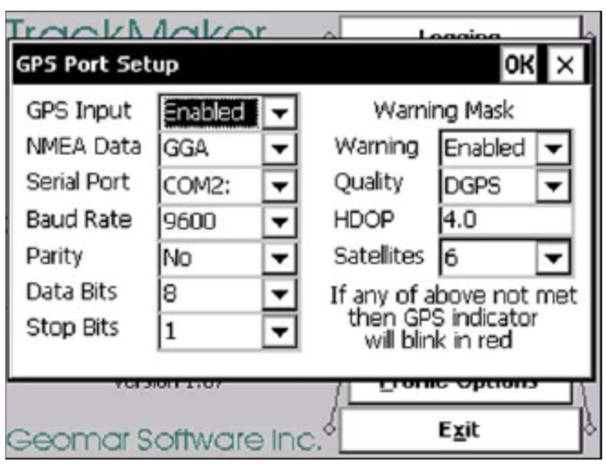




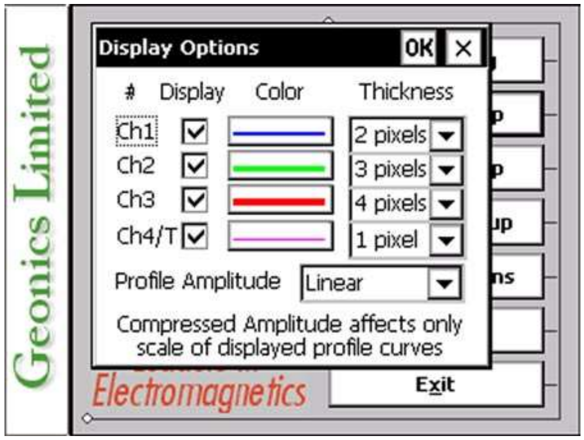
5. Click on "Logger Setup", and specify the following options. These settings will remain as defaults throughout the project.



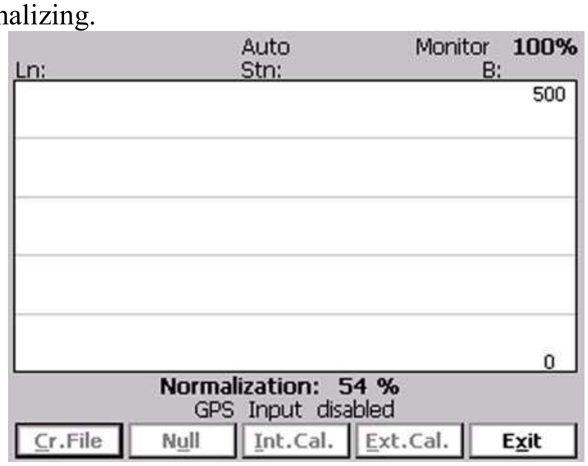
6. Click on "GPS Port Setup", and make sure the GPS Input is set to "Disabled", and all other options are grayed out.



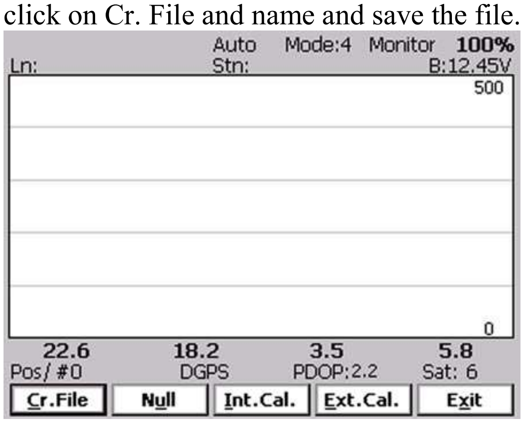
7. Click on "Display Options", and specify the following options. These options are also operator preferences for aesthetics and do not affect the collected data.

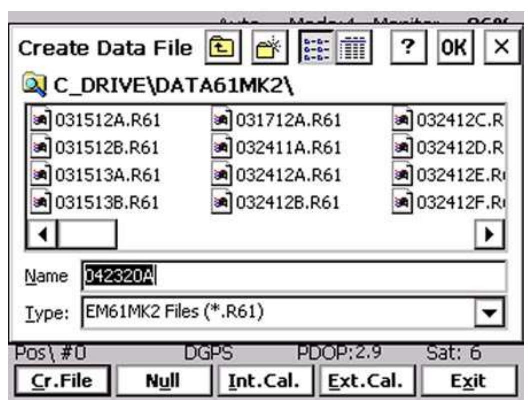


8. Once all parameters are set, click on "Monitor/Log". The screens shown below are displayed while the instrument is normalizing.

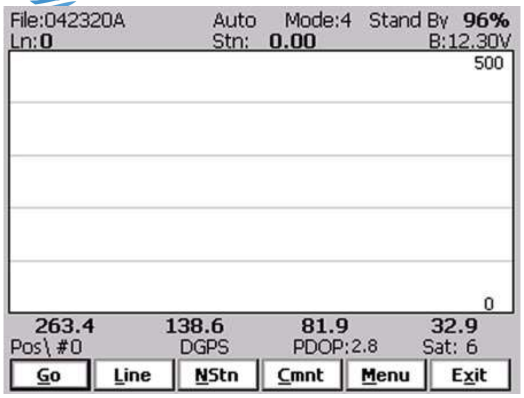


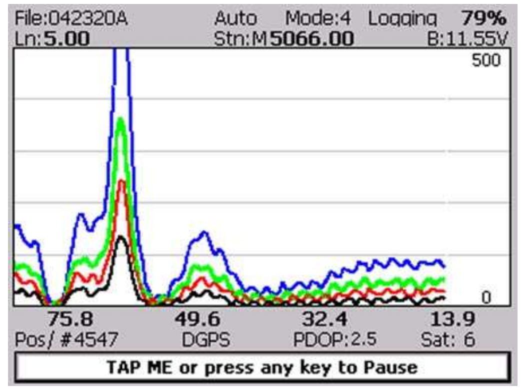
9. Once the Instrument has finished normalizing, find a quiet spot and Null the instrument. Then click on Cr. File and name and save the file.





10. 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.





11. On the screens shown above, the EM61-MK2 data are monitored.
12. At the end of the file, select the Exit button. The file automatically saves at the end of every line.

3.2. Towed Array Collection

The array consists of five overlapping 1m x 0.5m coils mounted on a durable poly-plastic wheeled platform. Coil heights are at the standard height of 40cm above the ground, equivalent to mounting the coils on their standard wheels. An all-terrain vehicle with an 18-foot tongue to maintain sufficient separation so that the vehicle does not influence the geophysical data tows the system. A single GPS sensor mounted over the center of the coils provides real-time positional tracking capabilities. System electronics are securely mounted in the vehicle's rear compartment while the laptop computer is located in the driver's compartment to allow continuous monitoring of system function.

The system is operated at a maximum speed of approximately 5mph and readings will be collected at a rate of 18 per second.

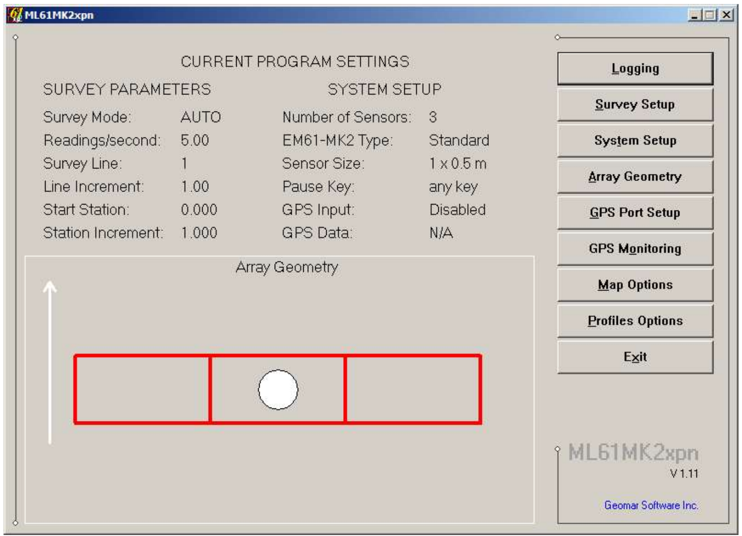
3.2.1. Navigation

Navigation will be accomplished using the FmX display consisting of a lightbar and an LCD screen that shows your location and intended path of travel. An RTK GPS antenna mounted on the roof of the all-terrain vehicle navigates the system. As discussed above, an additional GPS antenna centered over the three coils is used to position the EM61-MK2 array data.

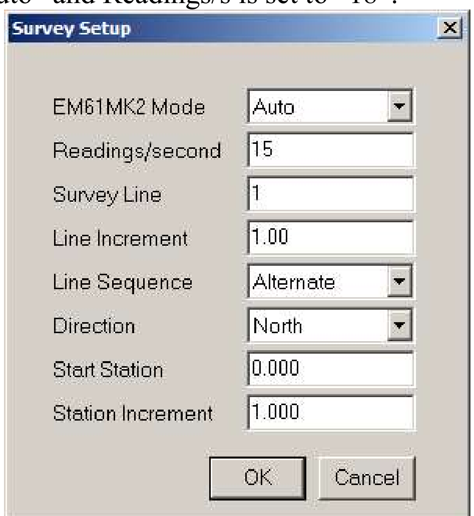
3.2.2. Data collection Steps

Below are the steps to begin surveying:

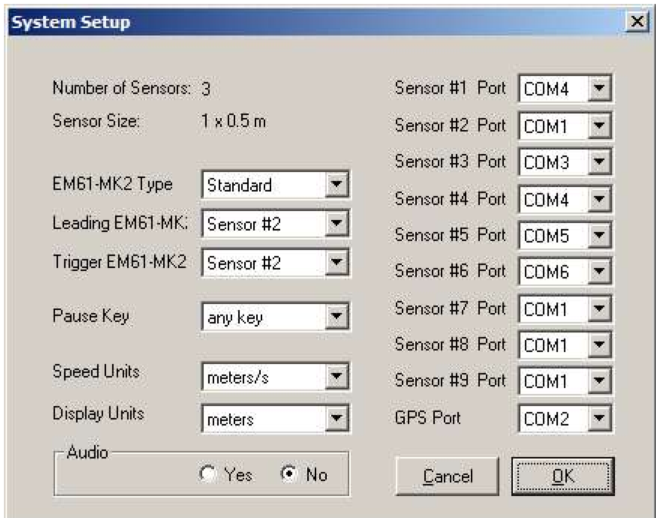
1. Turn on instrument by pushing in the fuse on the top of the console/electronics
2. Allow instrument to warm up for at least 15 minutes
3. Turn on Toughbook and open Multi61MK2xpn program. The screen below will be displayed.



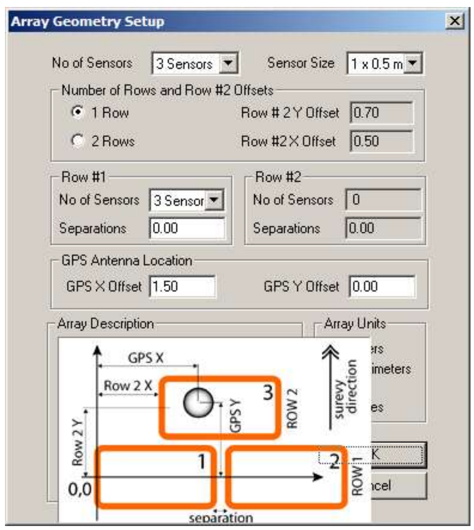
4. Click on "Survey Setup" and specify the below options. Two important options are the mode and reading/s. The Mode is set to "Auto" and Readings/s is set to "18".



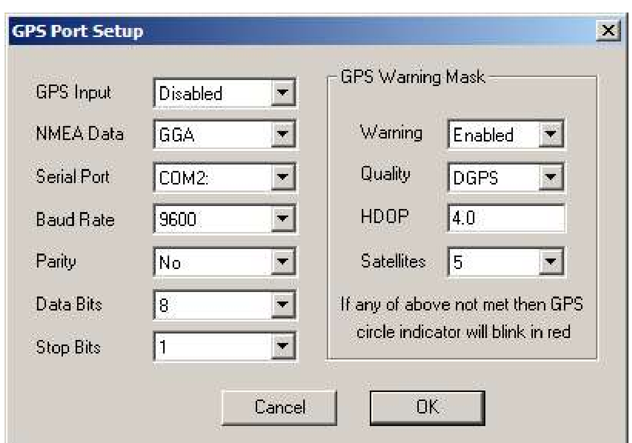
5. Click on "System Setup" and specify the below options. This is where all the ports are set for the three coils and the GPS string. These settings will remain the same throughout the project.



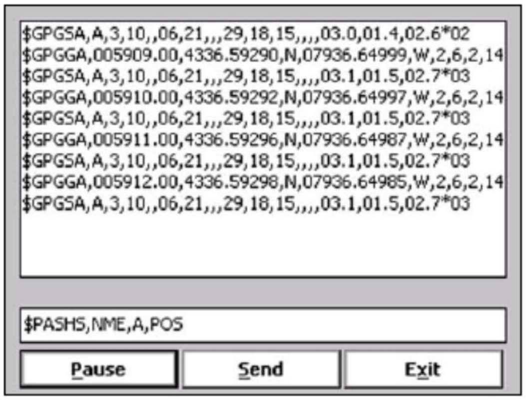
6. Click on "Array Geometry Setup" and enter the correct array geometry in the below options. This window is where the EM61 coils or positioned in relation to the GPS antenna. These settings will remain the same throughout the project.

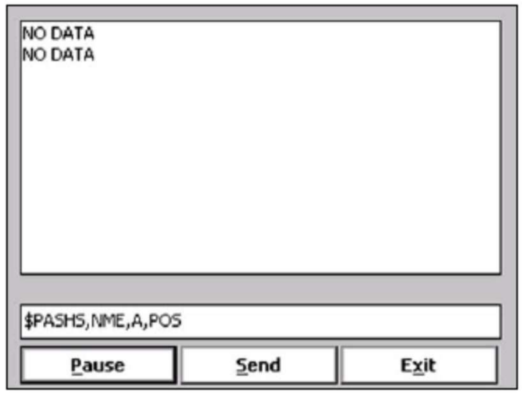


7. Click on "GPS Port Setup" and specify the below options. For GPS the below setting will be used. On the right side of the screen is where parameters can be set for alerts to go off if the GPS quality is inadequate.

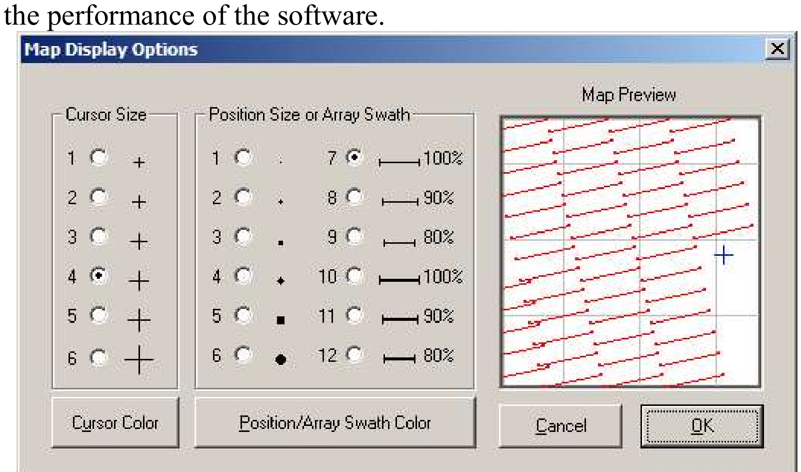


8. Click on "Monitor GPS" and the below window will open. If the NMEA string is coming in correctly, the screen will appear like the one on the left. If there is a problem with the baud rate, "No Data" will appear once a second. If there is nothing coming through "No Data" will flash once every 6 seconds.

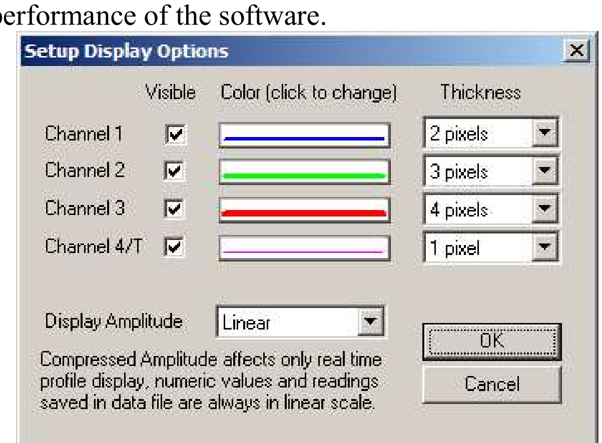




9. Click on "Map Options" and specify the below options. These are more operator preferences for aesthetics than for the performance of the software.



10. Click on "Profile Options" and specify the below options. These are more operator preferences for aesthetics than for the performance of the software.



11. Once all the parameters are set, click on the logging screen. The below will be displayed. Find a quiet spot and *Null* the instrument, then click on *File* and name your file and save it. Line up on the grid

or transect and select *Go*. The software will start logging the readings and a large *Pause* button will appear on the screen. At the end of the line, tap the *Pause* button or hit enter on the keypad.

12. On the above screens, both the EM61-MK2 data and the GPS data are monitored, as well as the data coverage.
13. At the end of the file, select the *Exit* button. The file automatically saves at the end of every line.

4. Data Management

The following sections describe the data that is needed to perform this SOP and the resulting data.

4.1. Person Portable Collection

4.1.1. Data Storage and Preliminary Processing

Person-portable EM61-MK2 data for both RTK-GPS and fiducial positional mode are temporarily stored in an Allegro data logger via Geonics' EM61MK2 software and then downloaded into a laptop computer for further on-site processing using DAT61MK2 and Geosoft Oasis Montaj software. Initial data processing is performed by the field team and includes reviewing data for integrity and repeatability. In the case of fiducial mode, positional data are edited based on the known locations of line ends and fiducial marks. Once deemed of acceptable quality the data is then uploaded to a file sharing site for data processing at the end of each day.

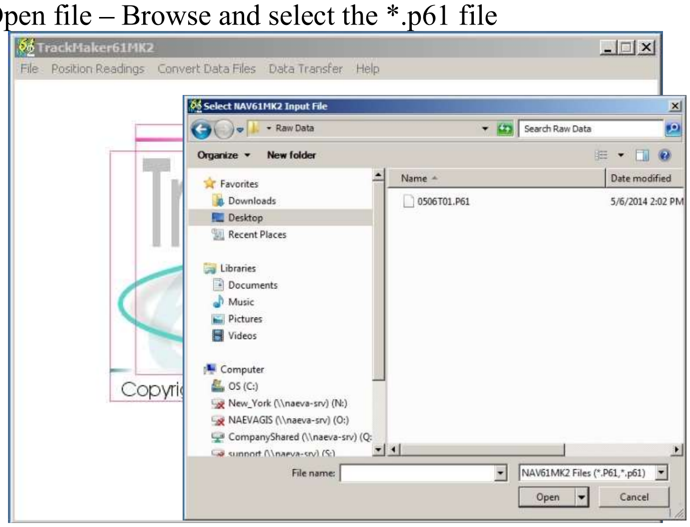
4.1.2. Data Storage and Editing

Once downloaded from the Allegro data collector, the person-portable data are stored directly into a ruggedized field computer. Below are the steps for using TrackMaker61MK2 to convert the raw p61 file into a Geosoft xyz data file. These steps, along with the downloading of the field data, may be performed in the field trailer.

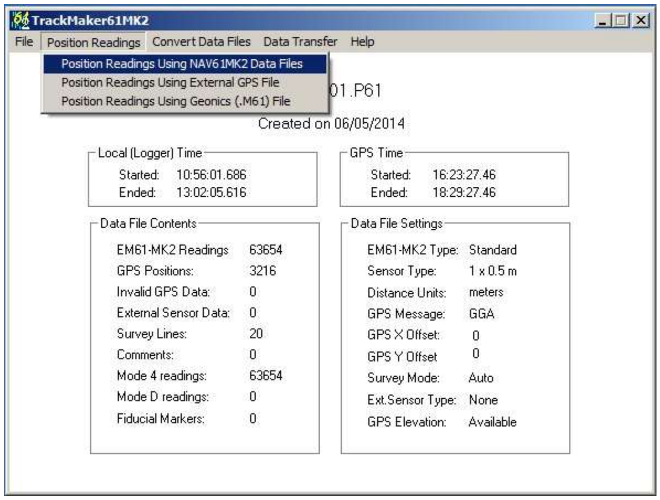
Data processing procedures for person portable data are described in SOP naeva-02 (Digital Data Processing and Interpretation).

The following steps are used to convert EM61-MK2 person-portable data with RTK GPS positioning to .xyz files:

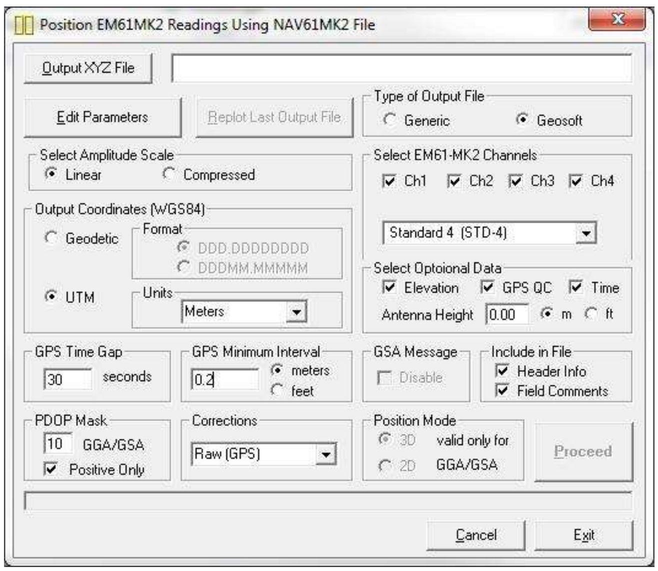
1. Go to "File" – Open file – Browse and select the *.p61 file



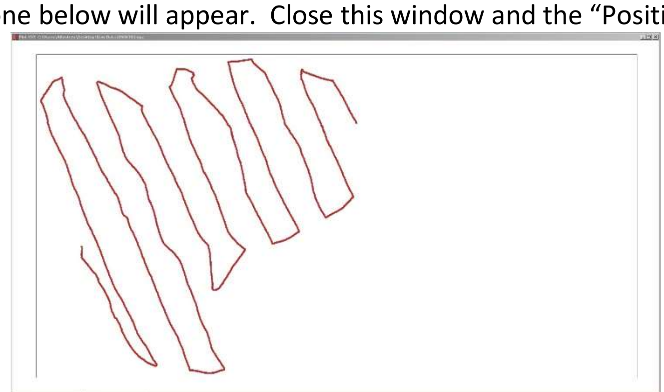
2. To create the Geosoft xyz data file
   - Go to "Position Sensors" and select "Position Selection using ML61MK2 data"



- Click on “Output XYZ File” and Browse for the location to save the Geosoft XYZ file

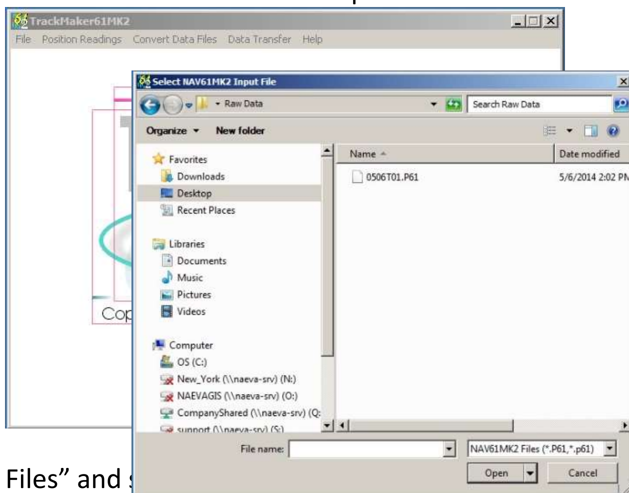


- Set parameters to the same settings in the above screen and Click “Proceed”
- A map like the one below will appear. Close this window and the “Position Sensors” window

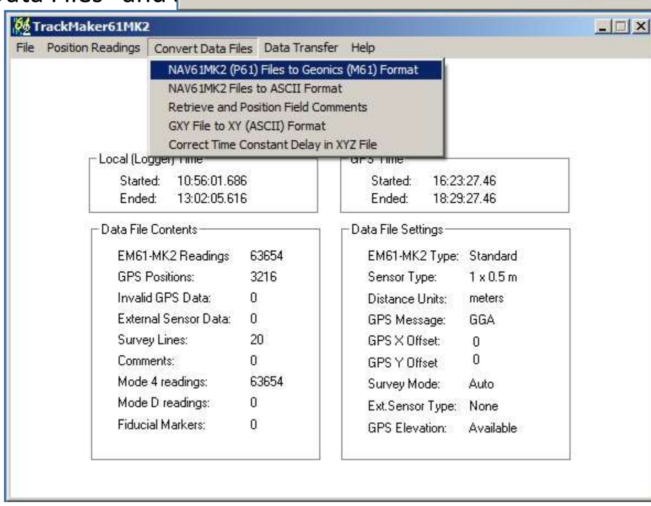


The following steps are used to convert EM61-MK2 person-portable data with fiducial positioning to .xyz files:

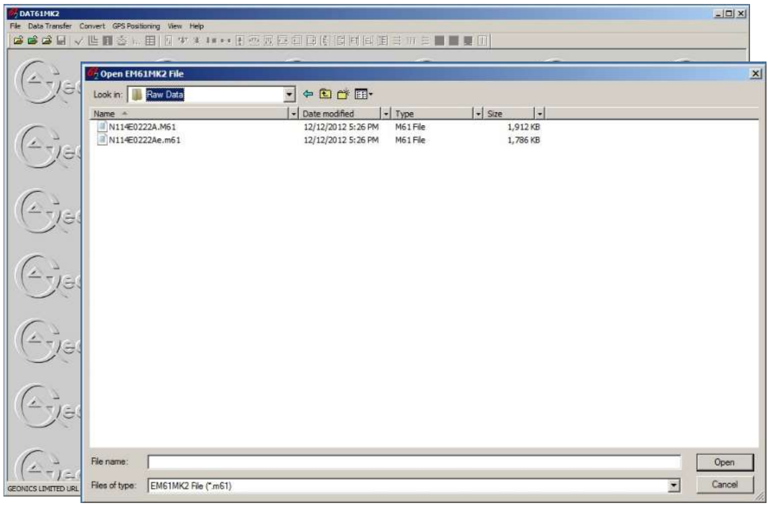
1. Go to “File” – Open file – Browse and select the *.p61 file



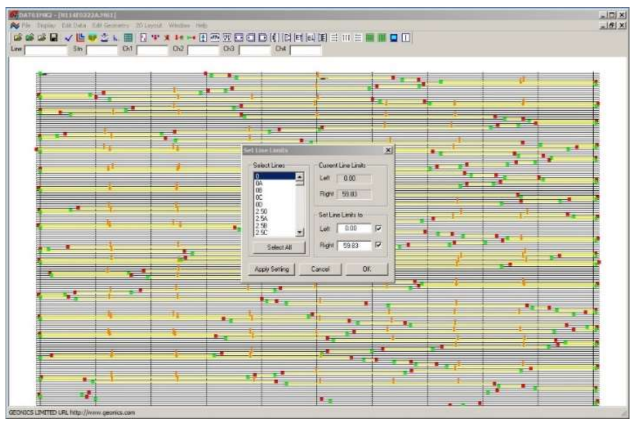
2. Go to “Convert Data Files” and s M61) Format”



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

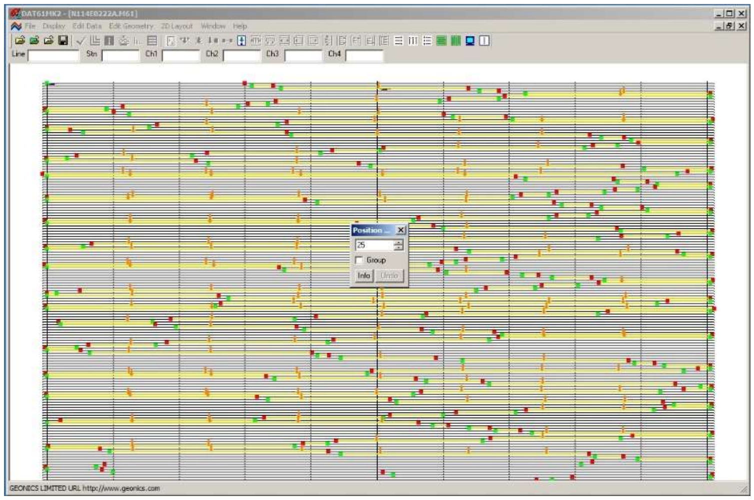


5. To edit the end points, go to “Edit Geometry” – “Set Line Limits” and the following screen will appear



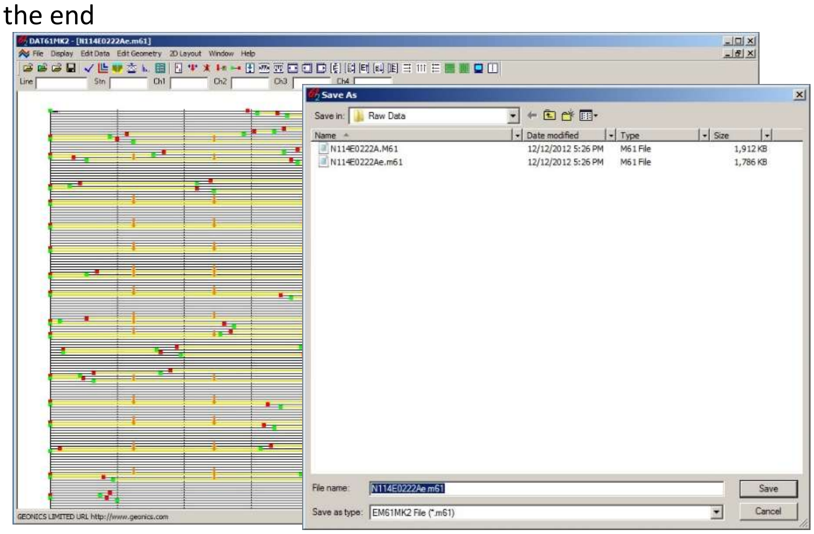
- Select a line of data and edit the appropriate end point in the “Set Line Limits to” box
- Click “Apply Setting” and move to the next line of data until all lines have been edited
- Click “OK”

To edit the fiducial marks, go to “Edit Geometry” – “Position Markers” and the following screen will appear



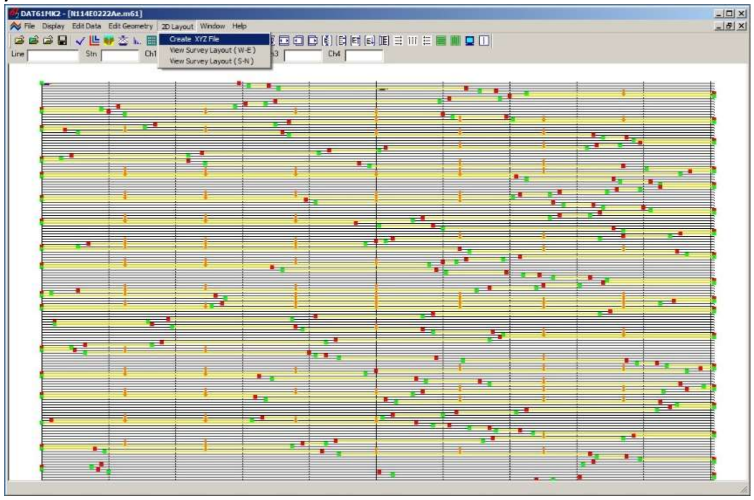
- Enter the value of the first fiducial mark to edit and click on each mark with that position, or:
- Enter the value of the first fiducial mark to edit, click on the “Group” check box, and draw a box around each mark with that positing
- Continue until all fiducial marks have been edited close the Positioning dialog box

6. 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

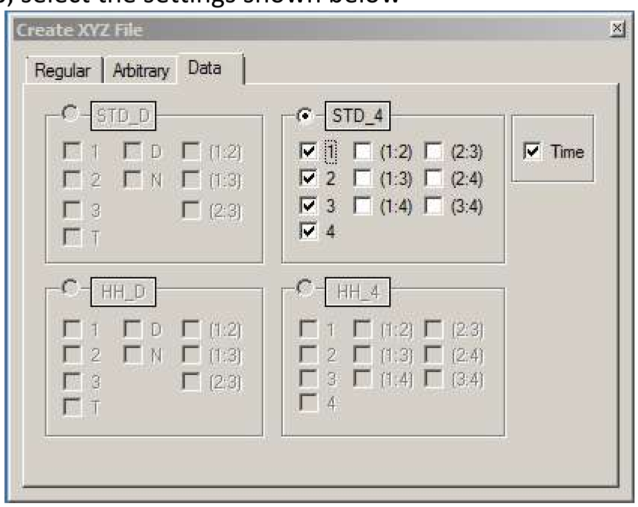


7. To create the Geosoft XYZ file

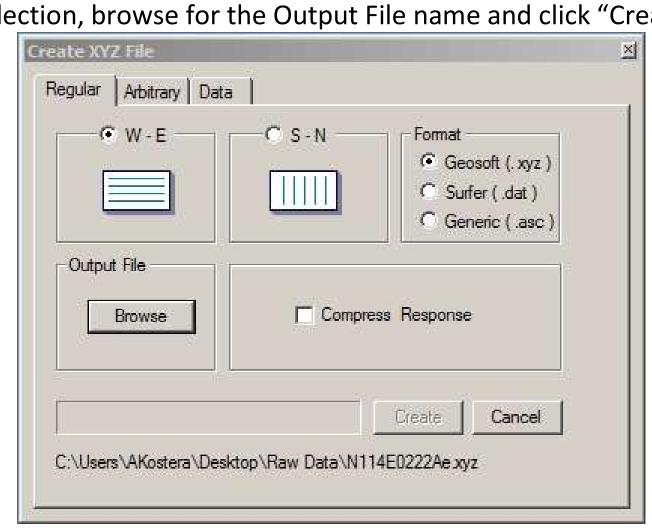
- Go to “2D Layout” and select “Create XYZ File”



- On the “Data” tab, select the settings shown below



- 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”

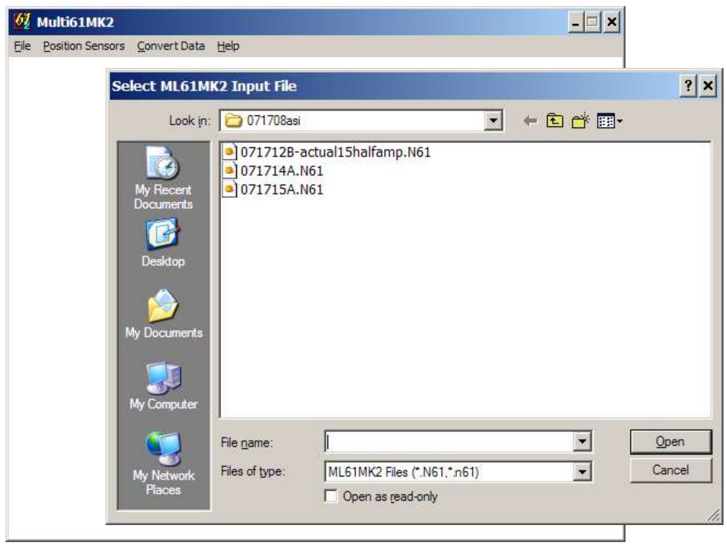


4.2. Towed Array Collection

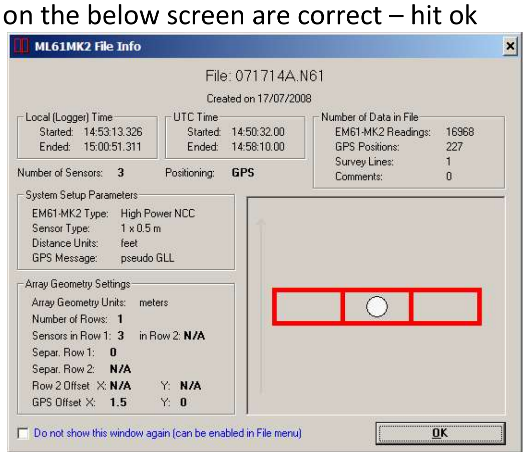
4.2.1. Data Storage and Editing

The array data is stored directly into a Panasonic Toughbook. Below are the steps for using Multi61MK2 to convert the raw n61 file into a Geosoft XYZ data file for processing and an M61 culture file.

1. Go to "File" – Open file – Browse and select the *.n61 file

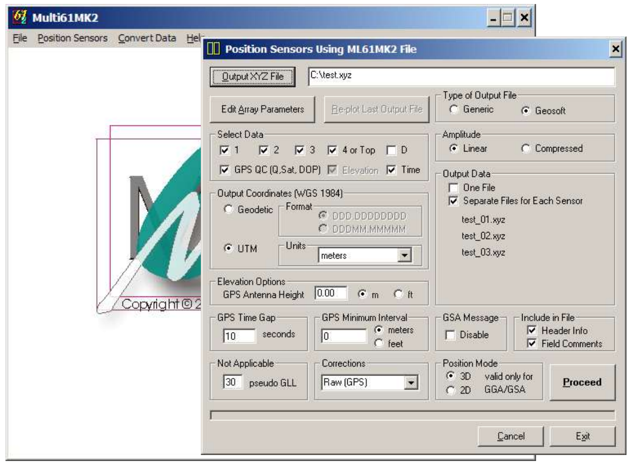


2. Make sure all settings on the below screen are correct – hit ok

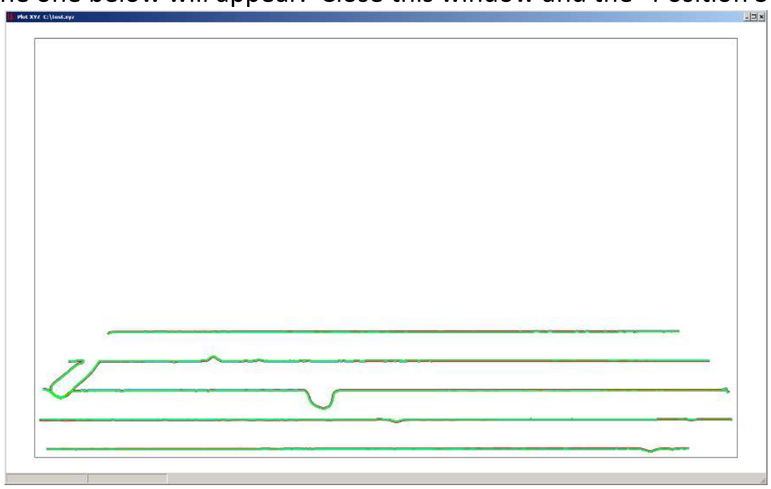


3. To create the Geosoft XYZ data file

○ Go to "Position Sensors" and select "Position Selection using ML61MK2 data"



- Click on "Output File" and Browse for the location to save the Geosoft XYZ file.
- Set parameters to the same settings in the above screen and browse for a location to save Geosoft XYZ file. Click "Proceed"
- A map like the one below will appear. Close this window and the "Position Sensor Window"



5. Quality Control

5.1. GEOPHYSICAL SYSTEM VERIFICATION (GSV) Process

The initial phase of the investigation to locate munitions and explosives of concern (MEC) as well as non-MEC metallic items in the subsurface will be the verification of the proposed geophysical system using Geophysical System Verification (GSV) process. The GSV process is two-fold:

- **Instrument Verification Strip (IVS)**: The objective is to verify that the geophysical detection system is operating properly. The IVS will contain a handful of Industry Standard Objects (ISOs) facilitating comparison of responses in the collected data with both historical measurements and physics-based model predictions.
  - **Industry standard Objects (ISO)**
    - The ISO (see Figure 1) to be used in the IVS are 1 inch (2.54 cm) by 4 inches (10.16

cm) steel pipes (part number 44615K466) from the McMaster-Carr on-line catalog (http://www.mcmaster.com/):

- Shape: Straight nipple, threaded both ends
- Schedule: 40
- Pipe Size: 1 inch (1.315-inch outer diameter)
- Length: 4 inches
- Finish: Black welded steel

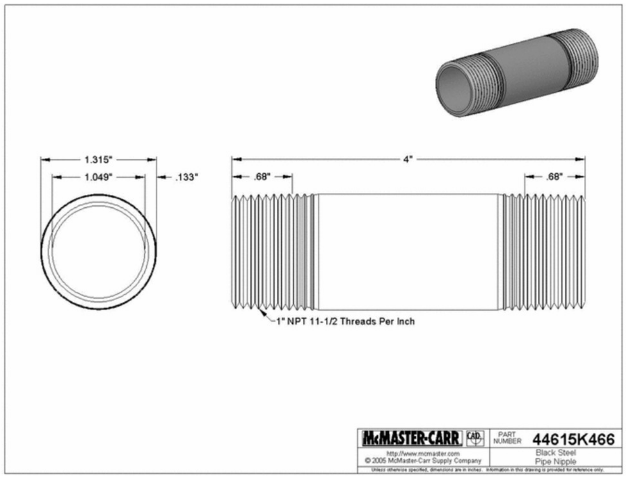


Figure 1: Industry Standard Object

- **Blind Seeding Program**: The production site will be seeded with ISOs at surveyed locations that are blind to the data collection and processing teams. The objective of the seed program is to provide ongoing monitoring of the quality of the geophysical data collection and target selection process as it is performed in the production survey throughout the project. The blind seeds will be numerous enough to be encountered on a daily basis, selected as potential targets and their responses consistent with both historical measurements and physics-based model predictions.

5.1.1. IVS

The same system and equipment that will be used to collect the geophysical site data will be deployed over the IVS. The IVS process is outlined in the following steps.

1. The IVS will be placed in a convenient location found to be relatively clear of subsurface metal and will provide for daily calibration tests.

a. Site Preparation and Limited Metal Debris Removal: If necessary, vegetation will be cleared from the IVS area to the same extent as anticipated for the field areas. The actual location of the test line will be checked using an EM61-MK2 prior to the burial of any seed items to ensure that other metallic contaminants are not present. In order to reduce the level of interference of non-munitions related metal debris during the geophysical investigation, removal of surface debris is planned.

2. A "background" DGM survey will be performed with the instrumentation to be validated over the IVS. This step will allow background geophysical conditions to be recorded, will help determine the appropriateness of the location (for example, few existing anomalies), and will verify that ISOs are not seeded near existing anomalies. The data will be post-processed and provided for evaluation.

3. Following verification that the IVS area is clear of subsurface anomalies (or existing anomalies can be avoided during seeding), two ISOs (per coil) will be buried per QAPP Worksheet #17. NAEVA personnel will bury the ISOs using shovels to dig the holes to the appropriate depths for burial. The background survey data and anomaly avoidance techniques will be used to ensure that corner stakes and ISOs are not placed on top of or near existing anomalies. Personnel will emplace ISOs and record the emplacement data (depth, orientation, and azimuth).
4. NAEVA will use RTK GPS equipment to record ISO locations, for the center of the targets. For horizontal items, the location of the endpoints of the IVS will also be recorded.
5. A DGM survey will be performed by NAEVA over the IVS as specified in the *Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response, July 2009*. The data will be processed and interpreted by NAEVA. Data packages will be provided to the client for evaluation.
6. If the initial MQOs, described in the QAPP, have not been met, NAEVA will discuss whether modifications to instrumentation or procedures can be made to the DGM system in order to meet the MQOs.
7. Once the surveys have been performed and the system has been found to meet the initial (or modified) MQOs, the IVS will be complete.

5.1.2. Blind Seeding Program

The blind seeding program of the production site is an integral part of the GSV process. The seeds provide an opportunity for ongoing monitoring to build confidence that all the steps leading to the product from which targets are selected are working. The failure to detect a seed target will allow the project team to recognize that problems exist and provide a mean to identify root causes and undertake corrective action while still in the field.

Known objects will be buried at surveyed locations that are blind to the survey and data processing teams at a sufficient frequency (1 per team per day) so that they can be used for daily quality checks. The purpose of the seeds is to provide ongoing verification that known objects produce signals that are expected. The seeds will be planted within the expected detectable range of the sensors, so that if there is a failure to detect any seed it will be a meaningful indication that there is a quality failure. Since it would be hard to interpret missing an item if it is not expected to be detected 100% of the time, the seeds will be placed such that they should all be detected.

5.2. Daily QC Checks

The QC checks listed below are to be conducted after the instruments have been warmed up for at least 15 minutes. The following QC function checks are to be conducted at the beginning and end of each day (unless otherwise noted) for each of the towed array platforms at a location that is known to be free of anomalous responses:

- GPS Static Positional Test
- Static Repeatability Test
- Dynamic Repeatability Test (IVS)
- Cable Shake Test

- Tow Vehicle Elevated RPM Test

Below is a description of each of the QC checks listed above. QC check data is to be digitally recorded, stored offsite, and reviewed by the data processor on a daily basis. The results of the daily QC checks are to be recorded in both the QC documentation and in the database.

1. GPS Static Positional Test (AM only): NAEVA will conduct static repeatability tests of their RTK-GPS antennas. This test will be completed at the beginning of each day at the IVS. The data for these GPS Static Positional Tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

2. Static Repeatability Test (AM and PM): NAEVA will conduct static repeatability tests (background and spike) over each of the EM61-MK2 sensors (5 for the TA system and 1 for the PP system). These tests are to be conducted over each of the coils and is to be completed twice daily at the IVS and will include 1 minute for background, 1 minute for spike, and 1 minute for an additional background reading. The baseline mV value for the static tests will be the average of AM and PM static tests conducted during the first week that the towed array system(s) is operational. The data for these static repeatability tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

3. Dynamic Repeatability Test (AM and PM): NAEVA will conduct dynamic repeatability tests (background and spike) for each towed array system. These tests are to be completed twice daily (AM/PM) at the IVS. The baseline mV value for each of the IVS items will be the average of dynamic IVS tests conducted during the first week that the towed array EM61MK2 system(s) is operational. The data for these dynamic repeatability tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

4. Cable Shake Test (AM only): On a daily basis the EM61-MK2 and GPS instrument cables will be tested to verify that cable vibrations do not have a negative effect on the quality of the data. The cable vibration test will be conducted at the beginning of each work day prior to the commencement of that day's DGM survey operation. The data for these cable shake tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

5. Tow Vehicle elevated RPM response (AM only) (Towed Array Only). On a daily basis the effect of an elevated RPM will be tested to verify that an elevated tow vehicle RPM does not have a negative effect on the quality of the data. This RPM response test will be conducted at the beginning of each work day prior to the commencement of that day's DGM survey operation. The data for these tow vehicle elevated RPM response tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

6. Personnel Test (AM only) (Person-Portable Only): On a daily basis DGM personnel will be tested to verify that when in close proximity to the sensor that they do not have a negative effect on the quality of the data. This personnel test will be conducted at the beginning of each work day prior to the commencement of that day's DGM survey operation. The data for these personnel tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

All QC checks will be digitally recorded and analyzed to verify that all data is within acceptable operational parameters as outlined in the UFP-QAPP.

6. Reporting

Achievement of the RTK GPS Assembly MQO will be documented by the Field or Project Geophysicist by completion of the QC Checklist in Attachment 1 to this SOP and will be verified by the QC Geophysicist.

The QC Checklist will be completed by the Field or Project Geophysicist each time the GPS base station is assembled during the production survey and a copy of these completed checklists will be included with the Classification Project Report at the end of the project.

The field geophysicist/technician will measure the location of a known point and compare the result to the actual location (ground truth). Offsets less than 10 cm will satisfy the MQO. This check will be performed daily after starting the base station, storing the recorded point identified with the date in the field log.

7. Revision History

3-28-18 Initial publication after translation from NAEVA SOPs

4-13-18 Reformatted and rearranged paragraphs for clarity

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STANDARD OPERATING PROCEDURE DGM 02

EM61 Digital Data Processing

1. Purpose and Scope

The purpose of this Standard Operating Procedure (SOP) is to detail the procedures and operational methodologies associated with the processing of DGM data collected using person-portable and towed array methods in areas that are potentially contaminated with Munitions and Explosives of Concern (MEC). All data processing will be performed using Geosoft's Oasis Montaj software package equipped with the UX-Detect module.

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP.

The following individuals will be involved in the assembly and verification of the RTK GPS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

The following is a list of required equipment and materials:

- Geonics EM61-MK2
- Trimble R8/R7/5700 RTK (Real Time Kinematic) GPS

3. Data Processing Steps

Once the initial editing steps have been performed, as described in NAEVA SOP 1 (Digital Geophysical Data Collection), the data are turned over to NAEVA's processors for analysis, target selection, and preparation of deliverables. The processor will go through five steps before the final data packages are delivered.

3.1. QC of Field Forms

Inspect the contents of the field forms that have been uploaded into the database to ensure that the forms contain the following information:

- The appropriate dataset ID
- QC test file names (Static/Spike Tests, Personnel Test, Cable Shake Test and Latency Tests)
- Grid ID(s)
- Instrument used (EM61MK2 Wheeled, EM61MK2 Tandem, EM61MK2 Towed Array)
- Collection/navigation method (RTK-GPS or FID)
- Daily conditions

- Cultural features

3.2. Daily Function Test Processing

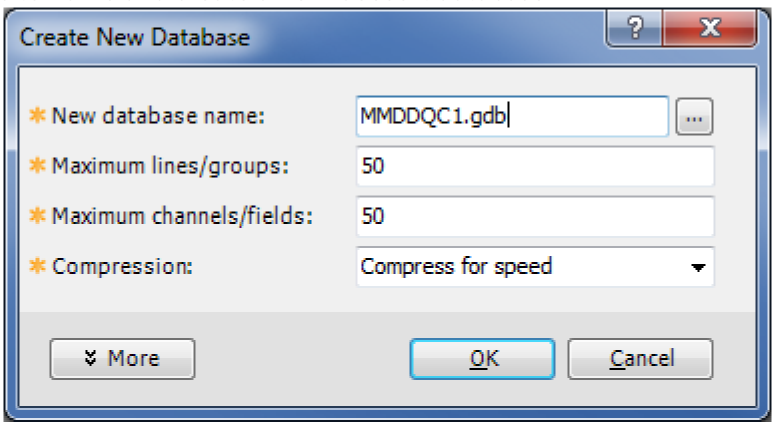
This stage includes processing of the daily function test data. Satisfactory performance of function tests with respect to the project Data Quality Objectives (DQOs) is evaluated.

A folder is first created where the Geosoft files are to be saved. Separate Geosoft project files are created for each test.

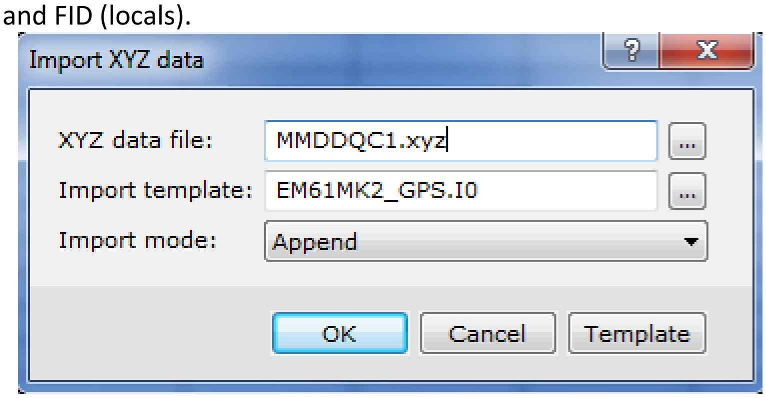
After the project is created, script files can be used in Geosoft to expedite the processing procedures. They are listed below with a brief description. Alternately, each step may be conducted manually.

1. **QC_Static_AM.gs, QC_Static.gs.** These scripts are partially interactive. QC_Static_AM.gs includes Static/Spike, Personnel/vehicle and Cable Shake test lines while QC_Static.gs includes just the Static/Spike test lines. The scripts do the following:

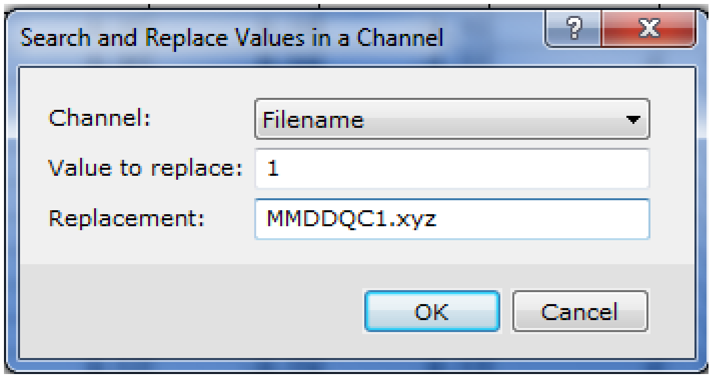
- Prompts to name and create a new Geosoft database.



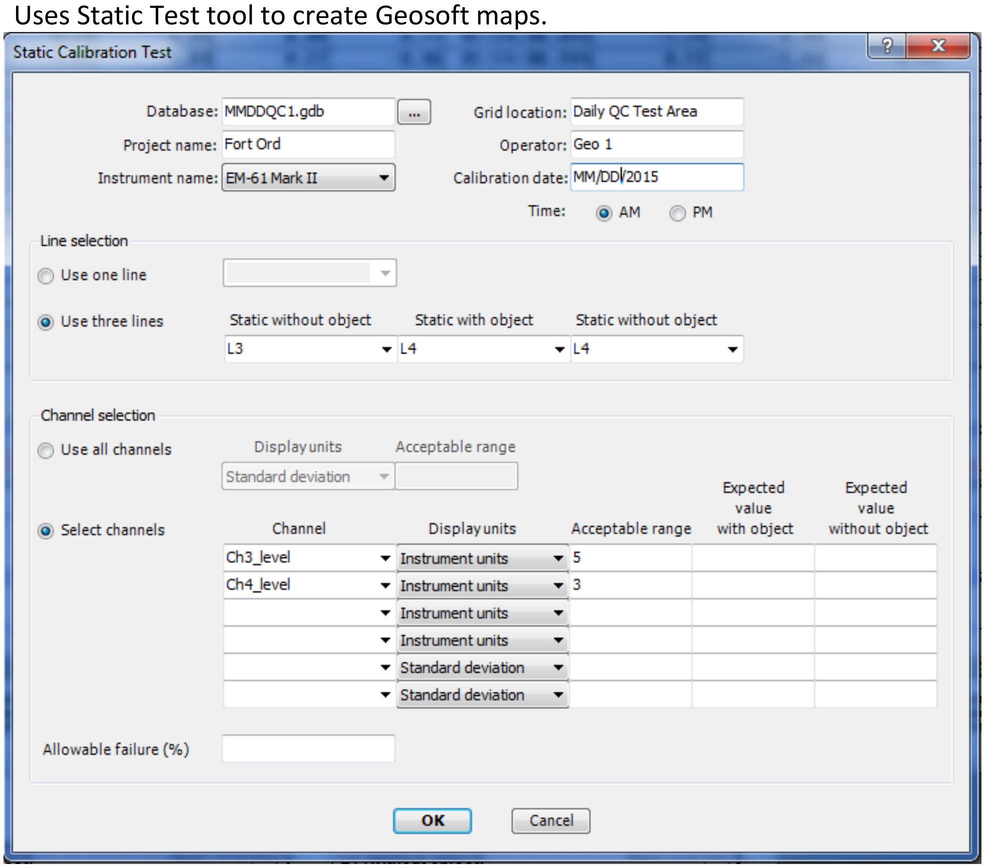
- Prompts to locate then import the raw Geosoft xyz file.
- Asks for the correct import template. For this project, there are two different import templates: GPS and FID (locals).



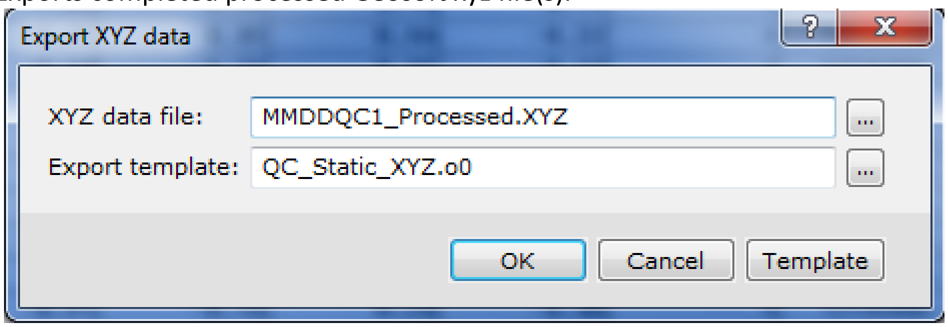
- Asks for the file name that was just imported.

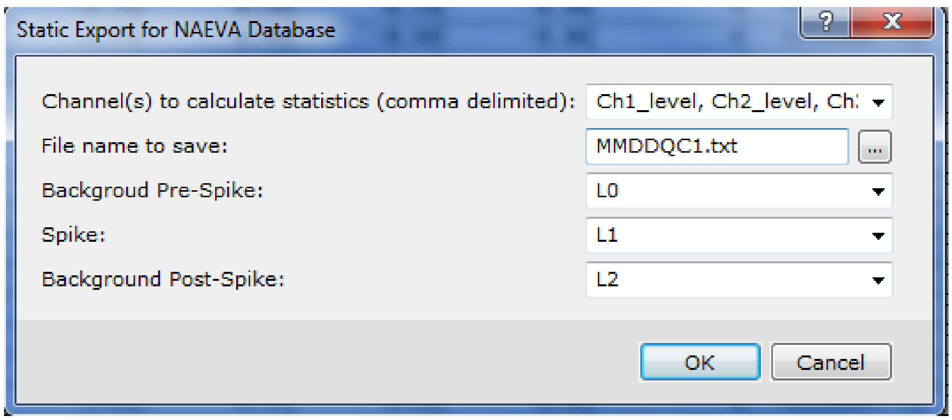


- Add coil ID numbering to database (TA only)
- Repeats import process for raw files from additional coils (TA only)
- Sets X and Y coordinate channels (either in georeferenced or FID locals).
- Performs preliminary auto leveling corrections to channels 1, 2, 3 & 4. The leveling gx is similar to the drift correct in Geosoft except that a median filter is used. Preliminary leveling for channel 1 is Low window = 0, High window = 80 and Window length = 1000. Preliminary leveling for channel 2 is Low window = 0, High window = 75 and Window length = 1000. Preliminary leveling for channel 3 is Low window = 0, High window = 65 and Window length = 1000. Preliminary leveling for channel 4 is Low window = 0, High window = 60 and Window length = 1000.
- Uses Static Test tool to create Geosoft maps.



- Calculates and exports background and spike statistics.
- Exports completed processed Geosoft xyz file(s).

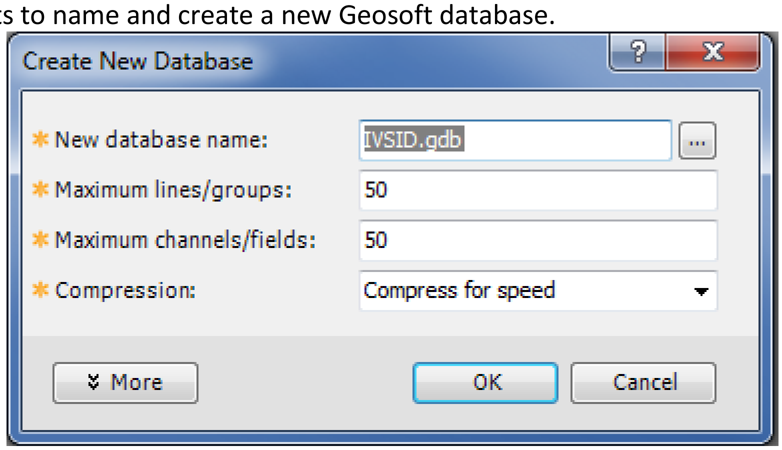




The Geosoft maps are printed as PDFs and the statistics are imported into the database.

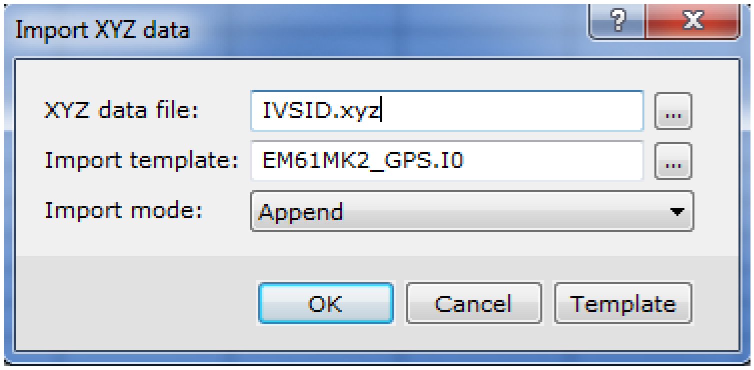
2. **QC_IVS.gs.** This script is partially interactive. It processes and evaluates the IVS test lines. The script does the following:

- Prompts to name and create a new Geosoft database.

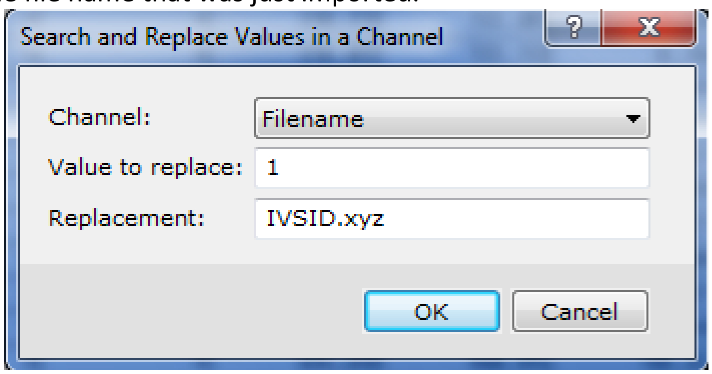


- Prompts to locate then import the Geosoft xyz file.

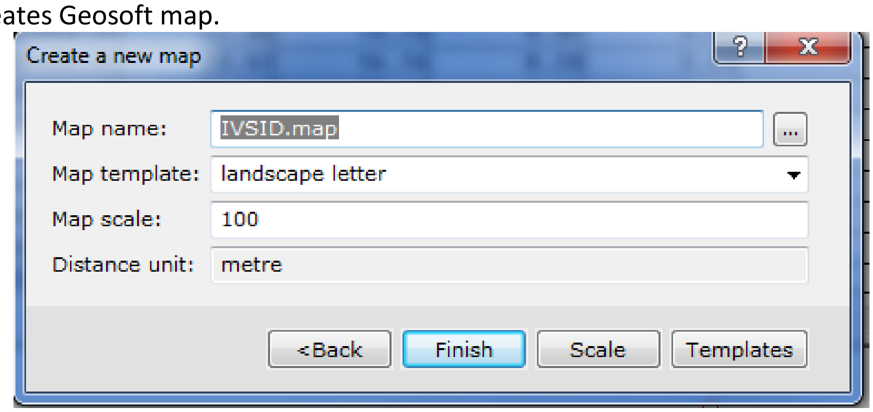
- Asks for the correct import template. For this project, there are two different import templates: GPS and FID (locals).

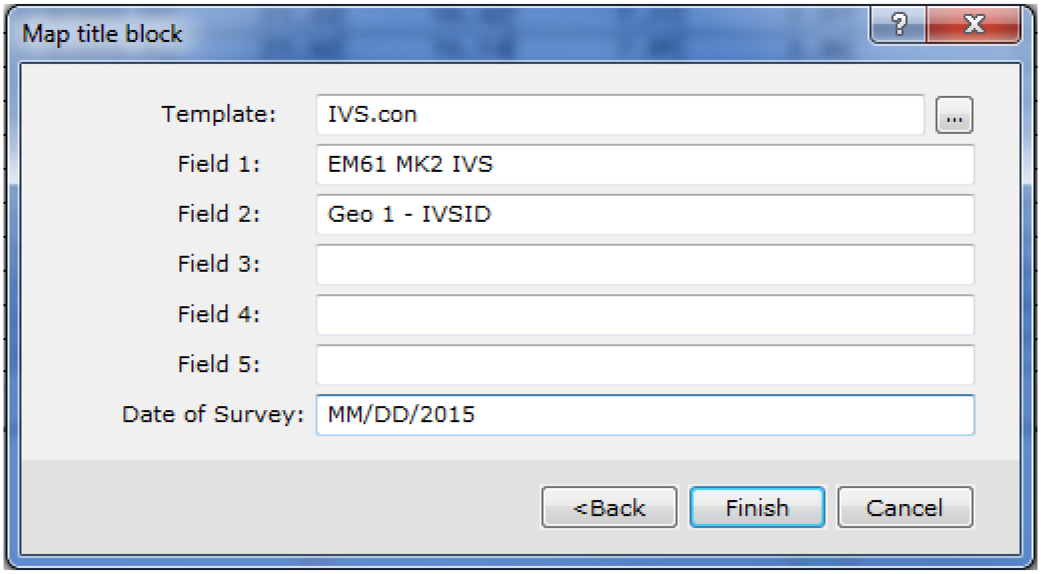


- Asks for the file name that was just imported.

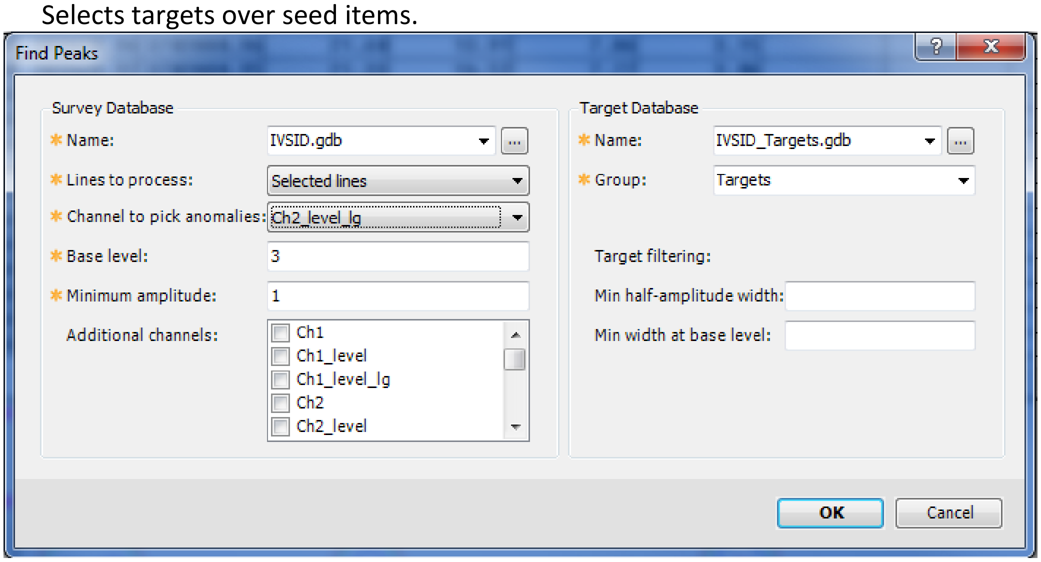


- Add coil ID numbering to database (TA only)
- Repeats import process for raw files from additional coils (TA only)
- Sets X and Y coordinate channels (either in georeferenced or FID locals).
- Performs preliminary auto leveling corrections to channels 1, 2, 3 & 4. The leveling gx is similar to the drift correct in Geosoft except that a median filter is used. Preliminary leveling for channel 1 is Low window = 0, High window = 80 and Window length = 100. Preliminary leveling for channel 2 is Low window = 0, High window = 75 and Window length = 100. Preliminary leveling for channel 3 is Low window = 0, High window = 65 and Window length = 100. Preliminary leveling for channel 4 is Low window = 0, High window = 60 and Window length = 100.
- Performs preliminary lag corrections to channels 1, 2, 3 & 4.
- Grids the corrected data for the selected targeting channel.
- Creates Geosoft map.

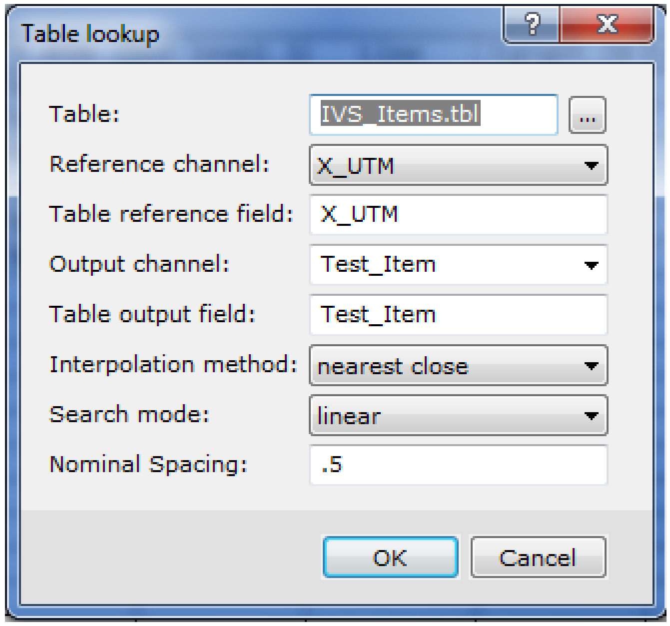


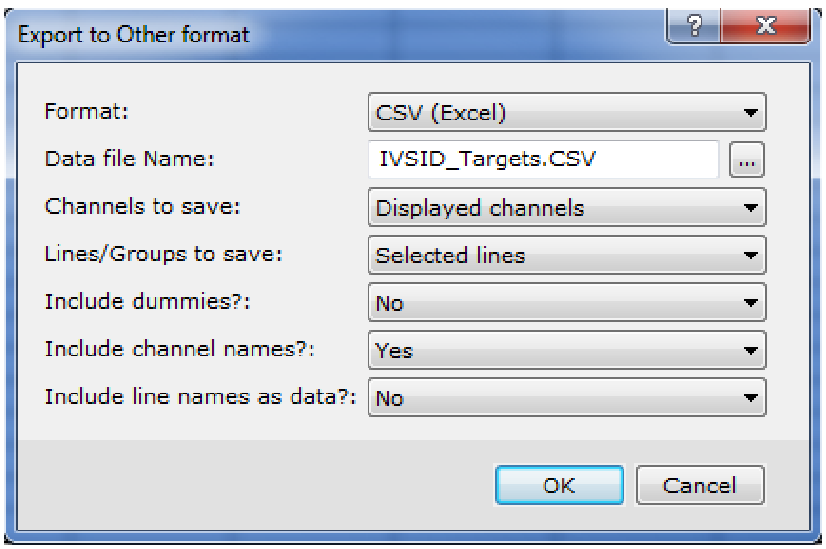


- Selects targets over seed items.

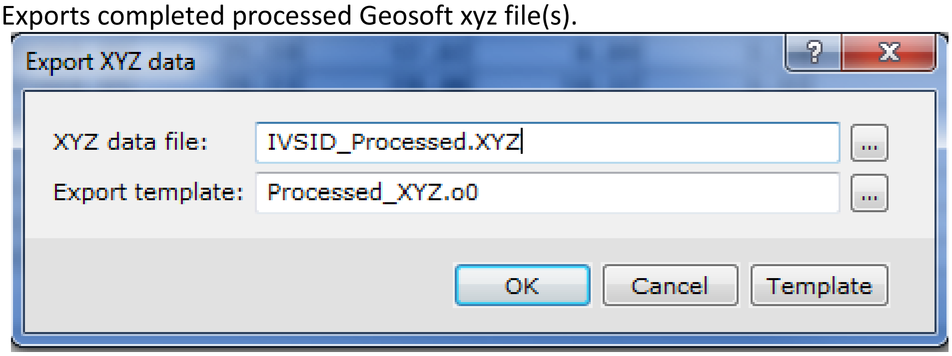


- Compares target locations and response(s) to expected values, export out target list.





- Exports completed processed Geosoft xyz file(s).



If needed, the leveling in the selected targeting channel will be refined by adjusting the window length. For example, a larger window length may be needed over very high response features. If needed, the lag/latency correction is also refined manually. If any of these manual adjustments are made, the data will be re-gridded and the target selections and statistics will be updated.

The Geosoft maps are printed as PDFs and the target lists are imported into the database.

3.3. Preprocessing

This stage includes preprocessing of the field data. Data are evaluated for the following:

- Data quality
- Location
- Coverage
- Line path positioning
- Down line density

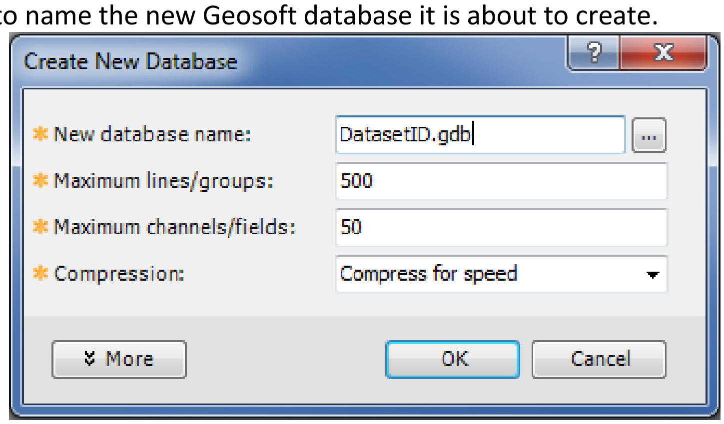
A folder is first created where the Geosoft files are to be saved. Separate Geosoft project files are created for each DGM dataset.

After the project is created, several script files can be used in Geosoft that help expedite the processing procedures. They are listed below with a brief description. Alternately, each step may be conducted manually.

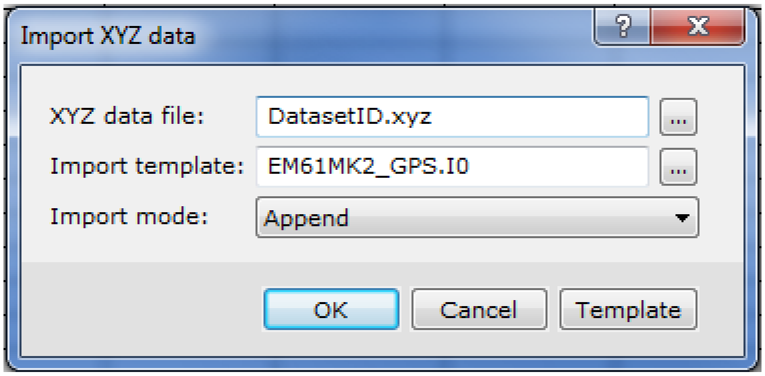
The following scripts apply to the person-portable DGM datasets:

1. **01_Setup.gs.** This script is partially interactive. It does the following:

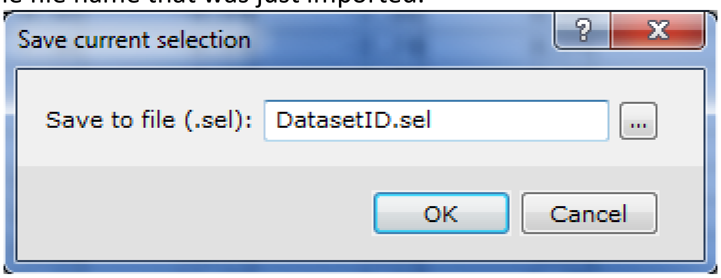
- Prompts to name the new Geosoft database it is about to create.

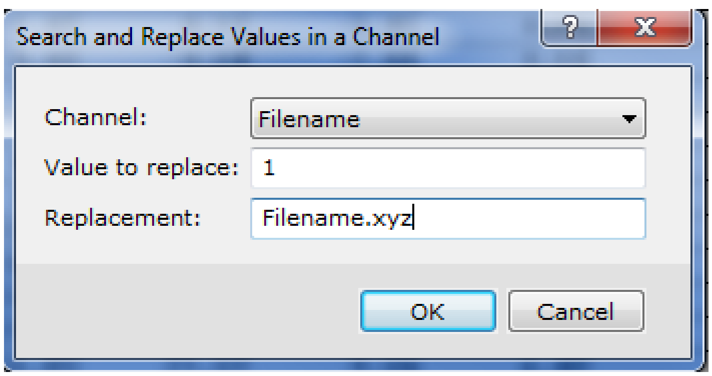


- Prompts to locate then import the Geosoft xyz file.
- Asks for the correct import template. For this project, there are three different import templates: Person-Portable GPS and FID (Locals) and Array.



- Asks for the file name that was just imported.



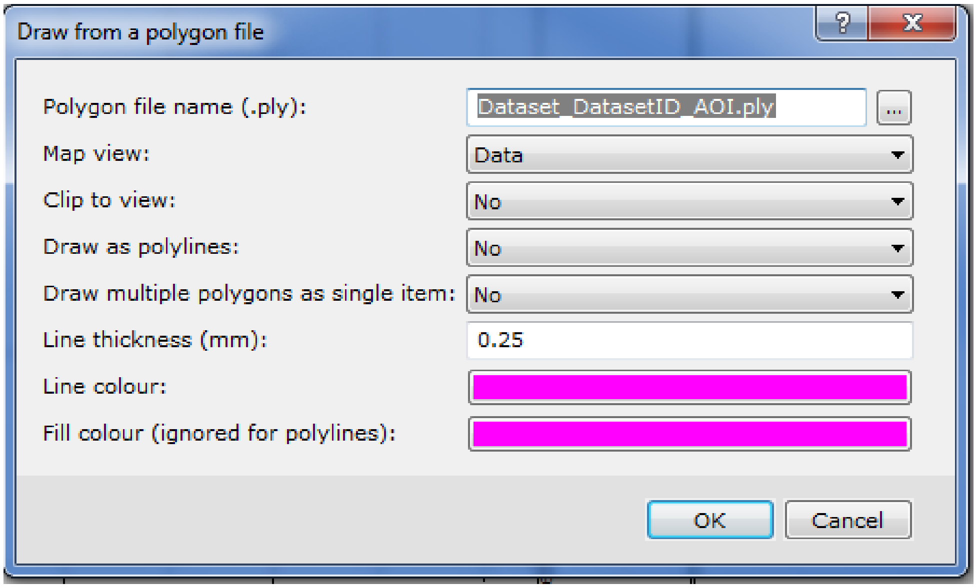


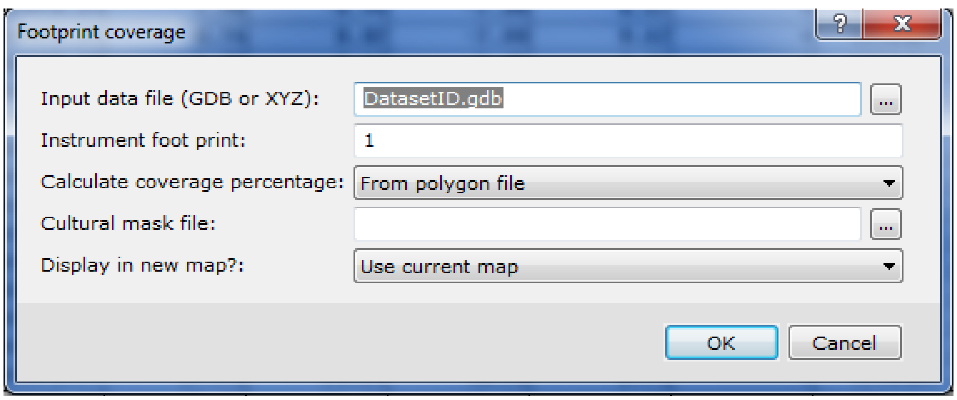
- Add coil ID numbering to database (TA only)
- Repeats import process for raw files from additional coils (TA only)

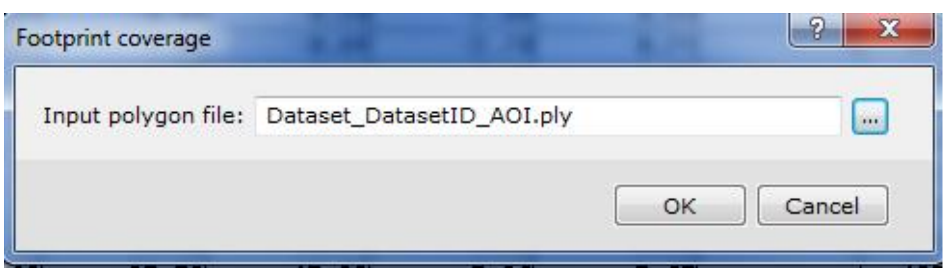
If there is more than one dataset xyz file then **02_Import.gs** will be needed. This script goes through the same steps as the 01_Setup script except naming and creating a new database. After all dataset xyz files are imported, move to the following script:

2. **04_Preprocessing.gs** (different scripts are used for GPS/RTK and FID)

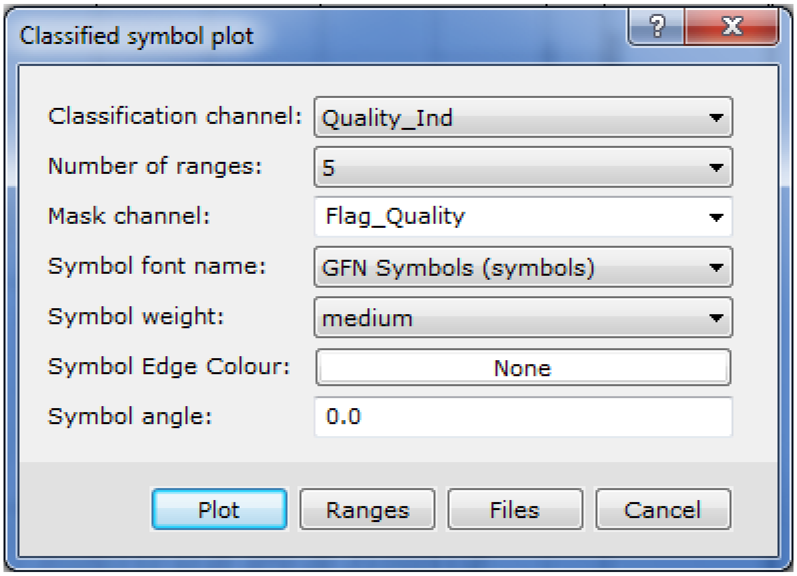
- Sets X and Y coordinate channels.
- Creates x_d and y_d channels by using the differences filter by 1.
- Creates a data_density channel then runs the following math expression: “data_density = sqrt((x_d*x_d)+(y_d*y_d)).
- Creates and displays a data density map showing the footprint of possible gaps and flags any readings that do not meet the DQOs.


Draw from a polygon file
Polygon file name (.ply):
Dataset_DatasetID_AOI.ply
Map view:
Data
Clip to view:
No
Draw as polylines:
No
Draw multiple polygons as single item:
No
Line thickness (mm):
0.25
Line colour:
Fill colour (ignored for polylines):
OK
Cancel


Footprint coverage
Input data file (GDB or XYZ):
DatasetID.gdb
Instrument foot print:
1
Calculate coverage percentage:
From polygon file
Cultural mask file:
Display in new map?:
Use current map
OK
Cancel


Footprint coverage
Input polygon file:
Dataset_DatasetID_AOI.ply
OK
Cancel

- Creates and displays a GPS Quality map (GPS Preprocessing), and flags any readings that do not meet the DQOs.



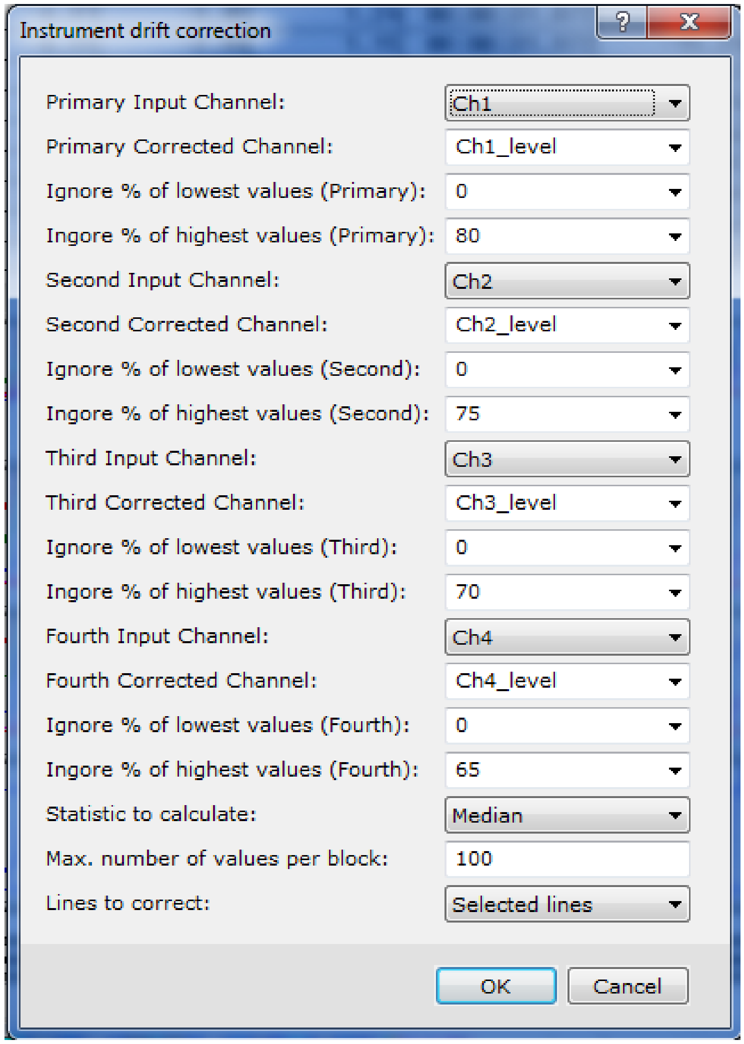
- Performs preliminary auto leveling of channels 1, 2, 3 & 4. The leveling gx is similar to the drift correct in Geosoft except that a median filter is used. Preliminary leveling for channel 1 is Low window = 0, High window = 80 and Window length = 100. Preliminary leveling for channel 2 is Low window = 0, High window = 75 and Window length = 100. Preliminary leveling for channel 3 is Low window = 0, High window = 65 and Window length = 100. Preliminary leveling for channel 4 is Low window = 0, High window = 60 and Window length = 100.
- Performs preliminary lag correction of channels 1, 2, 3 & 4.
- Grids raw, leveled, and leveled and lagged data using Minimum Curvature or Kriging.
- Creates and displays preliminary contour maps of the selected targeting channel with line paths.

To finish the preprocessing, culture files are plotted on the preliminary maps and any GIS/CADD information is overlaid.

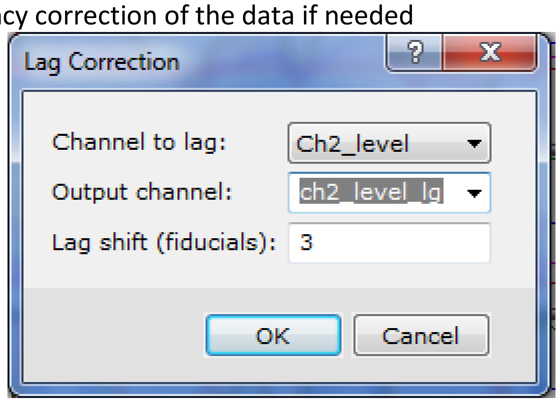
3.4. Final Processing

At this stage, the data processor opens the Geosoft project created during preprocessing and performs the following:

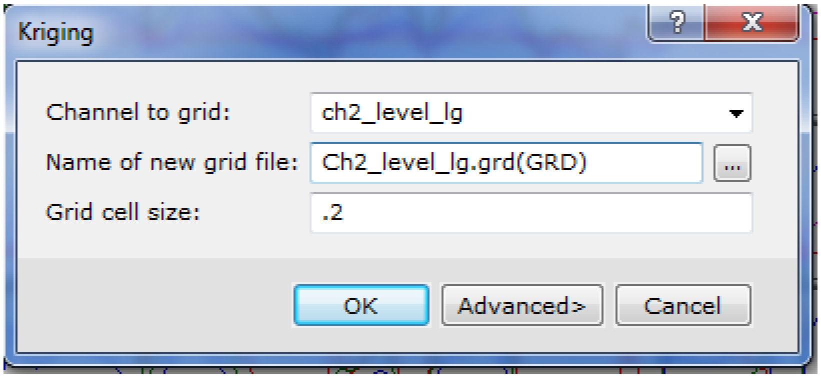
- Refines the leveling in the selected targeting channel. A larger or smaller window length will be applied if needed. For example, a larger window length may be needed over very high response features. Manual leveling may also be required.

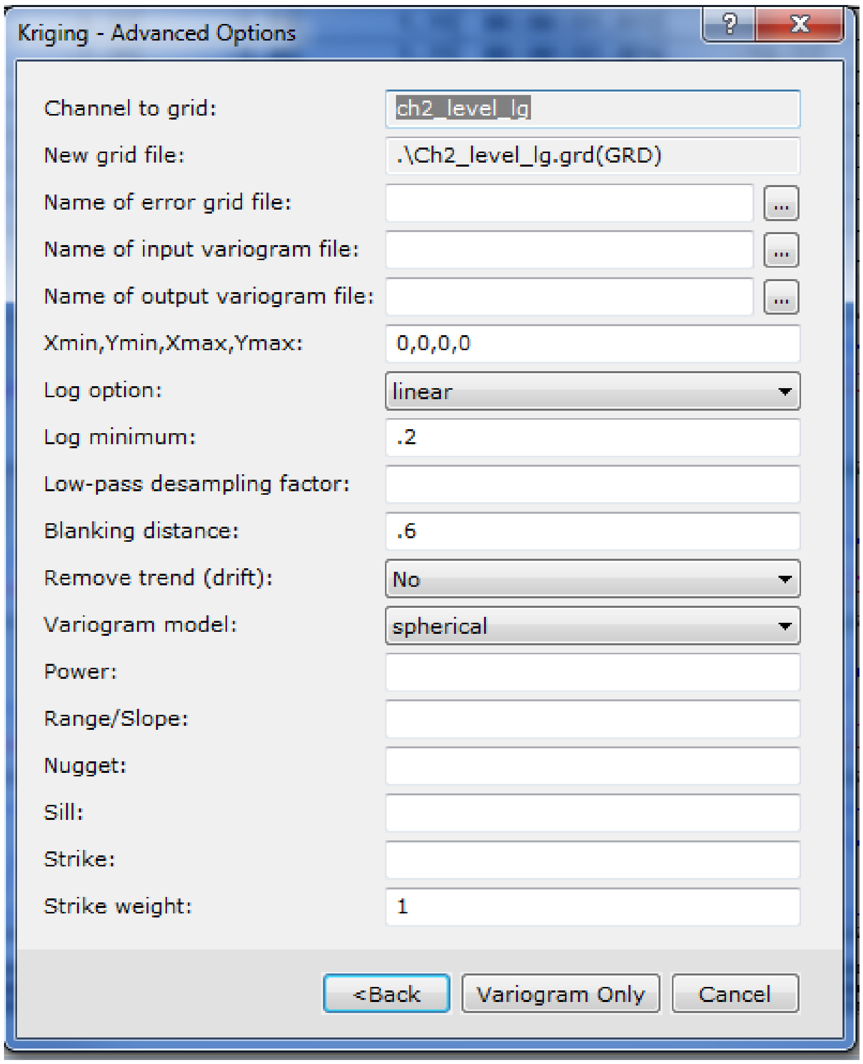


- Refines lag/latency correction of the data if needed



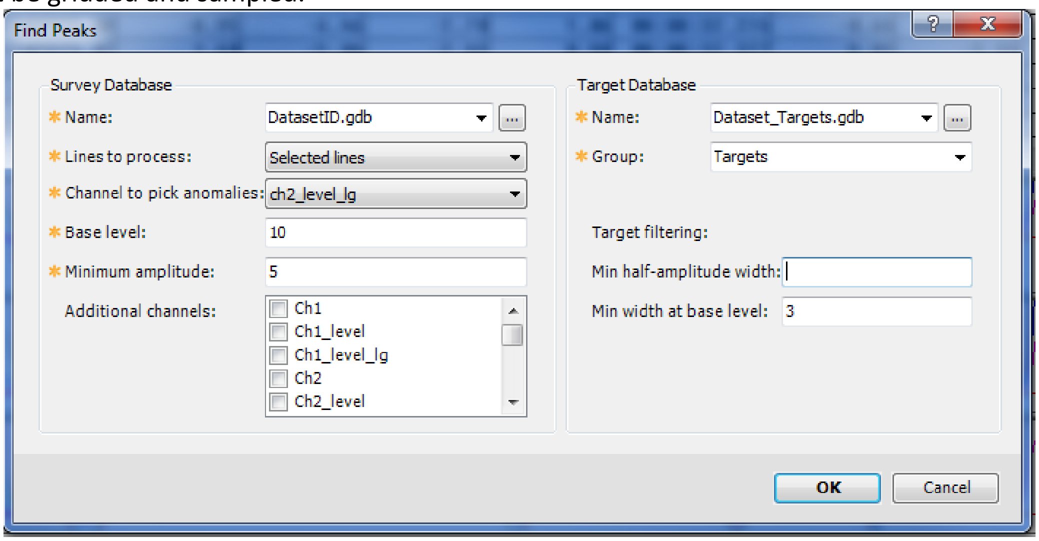
- Adds filters to the data if needed. Some filters that might be expected are non-linear, low pass, and high pass.
- Grids the data with Minimum Curvature or Kriging. Kriging better defines high response anomalies while Minimum Curvature may create false anomalies between lines near high response anomalies.


Kriging
Channel to grid:
ch2_level_lg
Name of new grid file:
Ch2_level_lg.grd(GRD)
Grid cell size:
.2
OK
Advanced>
Cancel

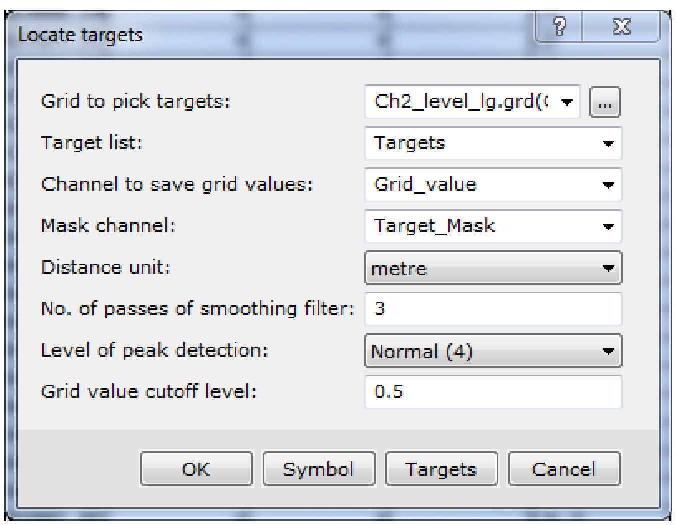

Kriging - Advanced Options
Channel to grid:
ch2_level_lg
New grid file:
.\Ch2_level_lg.grd(GRD)
Name of error grid file:
Name of input variogram file:
Name of output variogram file:
Xmin,Ymin,Xmax,Ymax:
0,0,0,0
Log option:
linear
Log minimum:
.2
Low-pass desampling factor:
Blanking distance:
.6
Remove trend (drift):
No
Variogram model:
spherical
Power:
Range/Slope:
Nugget:
Sill:
Strike:
Strike weight:
1
<Back
Variogram Only
Cancel

A target selection script is then run

- Selects anomalies in Geosoft's UX-Detect Module by using either "Pick Peaks Along Profile" or "Blakely Test". Profile picking is effective in low target density areas where discrete anomalies are present above background noise. Anomalies selected using profile picking, whose footprint crosses several survey lines, will have multiple targets selected that need to be reviewed and removed by the processor. Selecting targets from gridded data with the Blakely method is more efficient in high target density areas and less likely to place additional target selections across large footprint anomalies with only one distinct peak value for an anomaly that crosses several lines. The Blakely method requires that all data channels to be included on the target list must be gridded and sampled.



Pick Peaks Along Profile

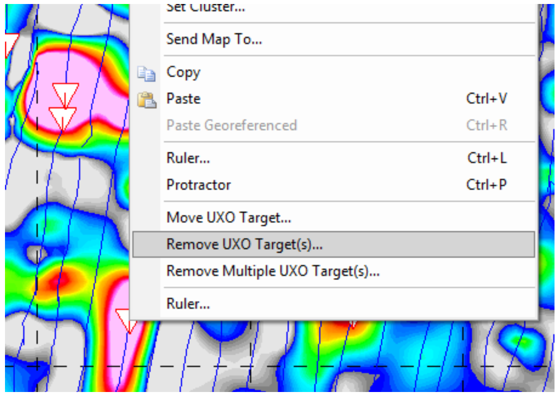


Blakely Test

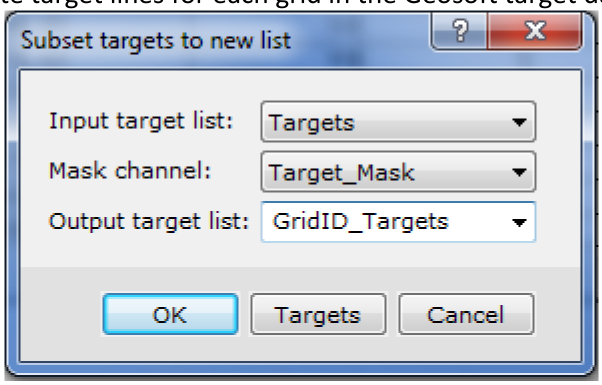
- Populates channel 1, 2, 3 & 4 response values
- Creates a comments channel that is used to add descriptive notes as needed.
- If needed, performs automated target checks, for example if Ch1>Ch2>Ch3>Ch4

To complete processing:

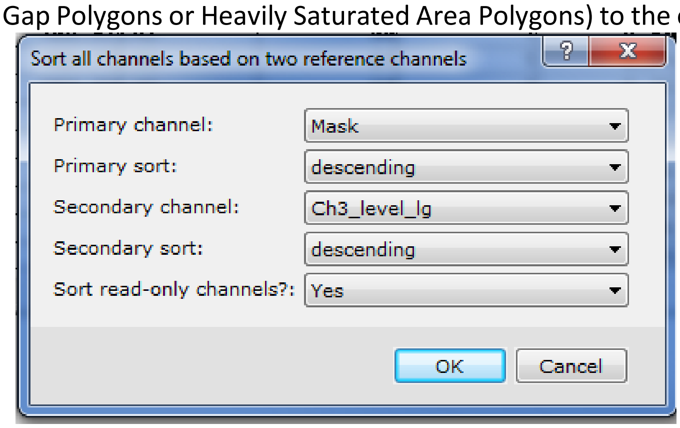
- Target selections are refined by checking their validity and position. Targets found to be invalid or incorrectly located are adjusted or removed. Additionally, anomalies not selected by UX-Detect, yet deemed to represent a potential UXO target, are manually selected. Comments channel is populated.



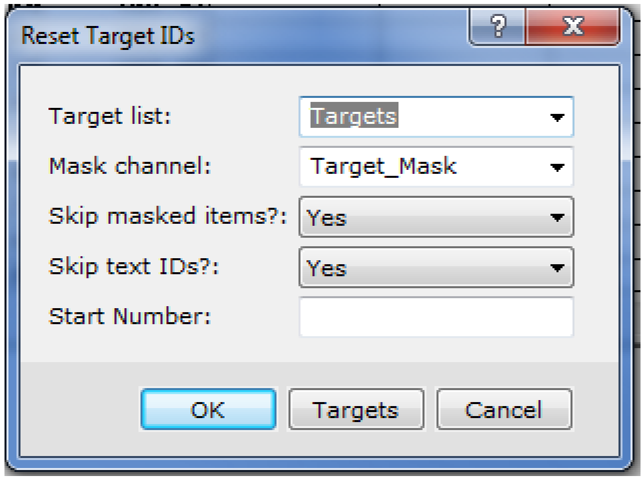
- Creates separate target lines for each grid in the Geosoft target database.



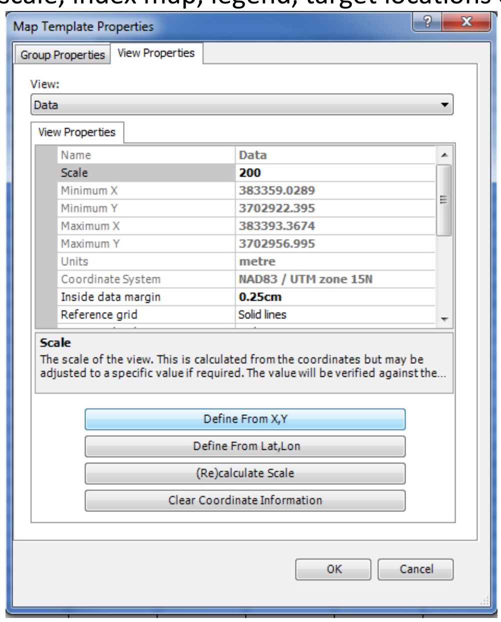
- Re-sorts the target database by amplitude and if needed, adds any additional polygon target points (Data Gap Polygons or Heavily Saturated Area Polygons) to the end of the target list.

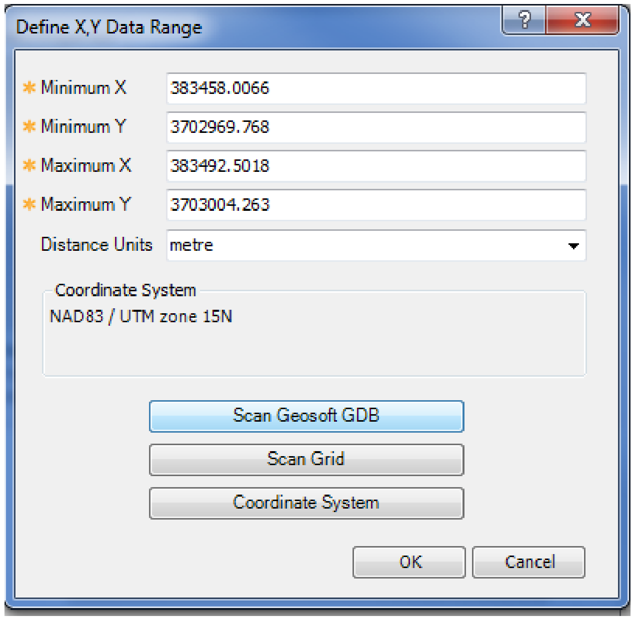


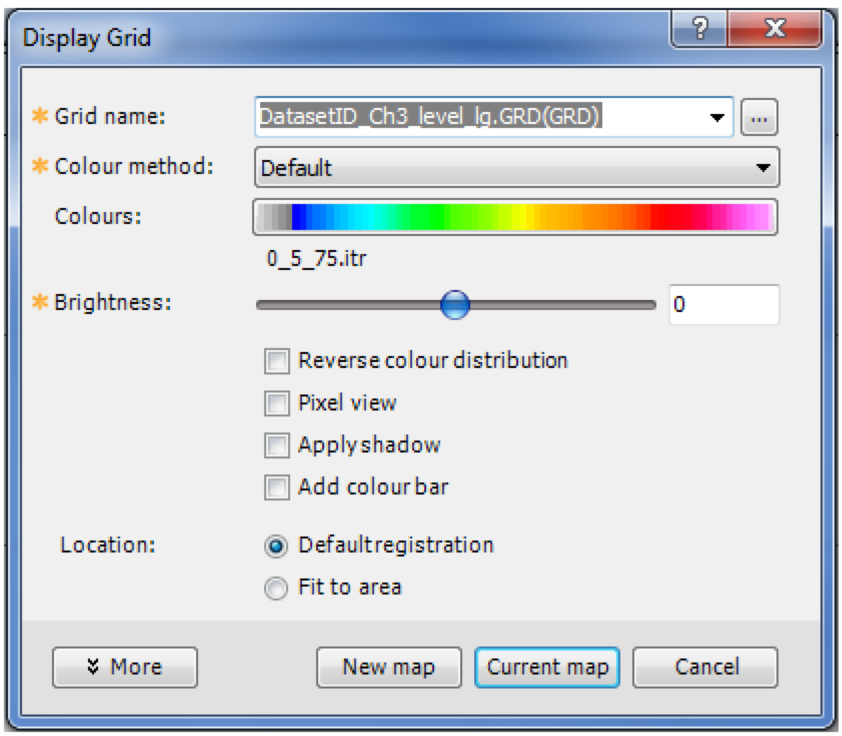
- Assigns unique target IDs.

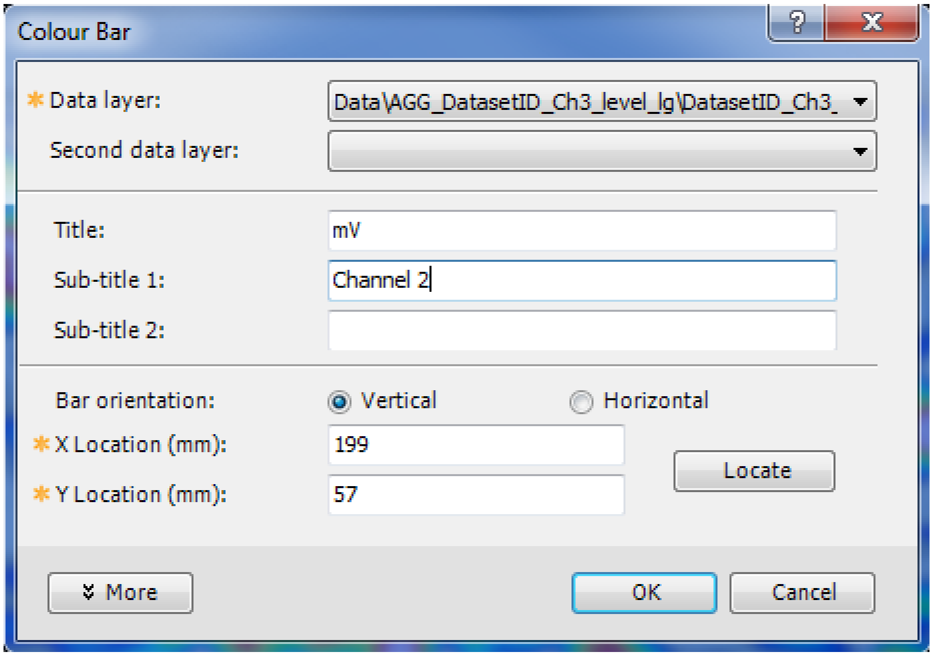


- Creates and displays a colored contour Geosoft map(s) of the grid cell(s) with the following; title block, color scale, index map, legend, target locations & target numbers.

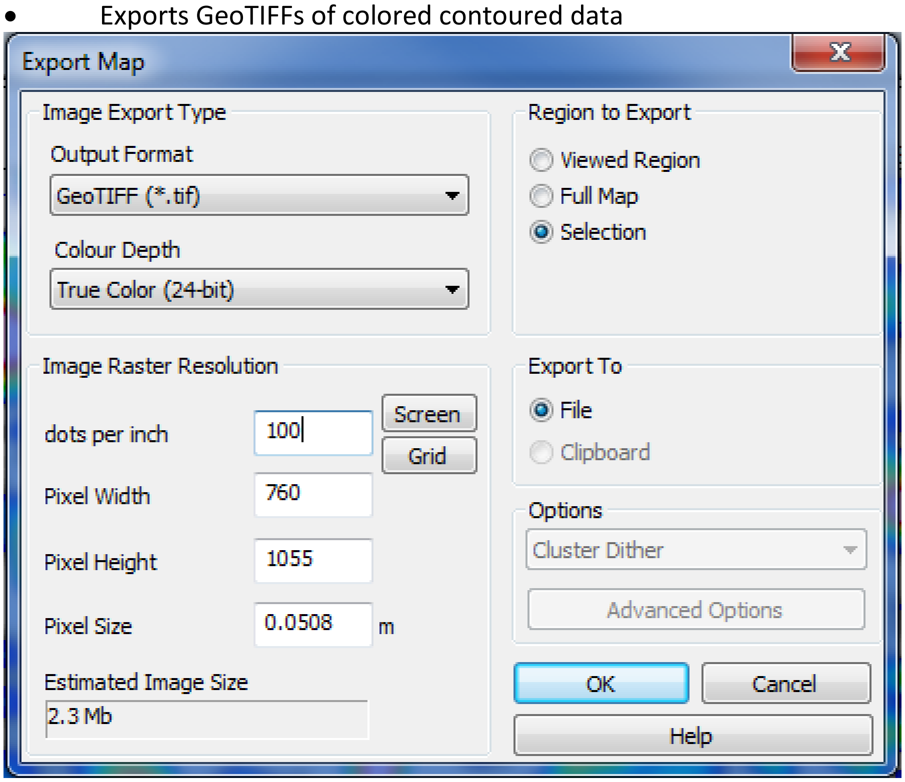



Define X,Y Data Range
Minimum X
383458.0066
Minimum Y
3702969.768
Maximum X
383492.5018
Maximum Y
3703004.263
Distance Units
metre
Coordinate System
NAD83 / UTM zone 15N
Scan Geosoft GDB
Scan Grid
Coordinate System
OK
Cancel

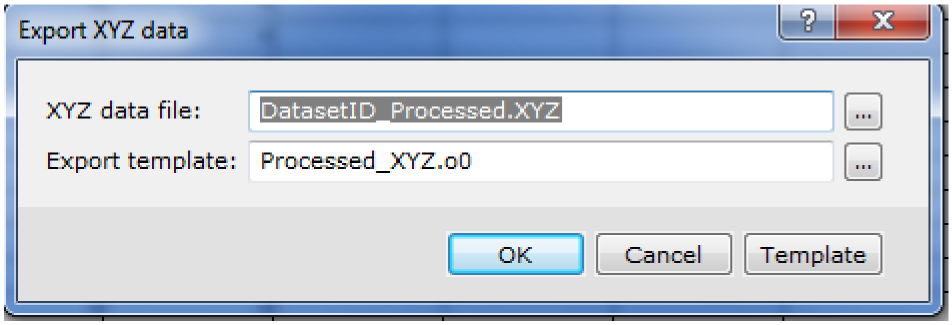

Display Grid
Grid name:
DatasetID_Ch3_level_lg.GRD(GRD)
Colour method:
Default
Colours:
0_5_75.itr
Brightness:
0
Reverse colour distribution
Pixel view
Apply shadow
Add colour bar
Location:
Default registration
Fit to area
More
New map
Current map
Cancel



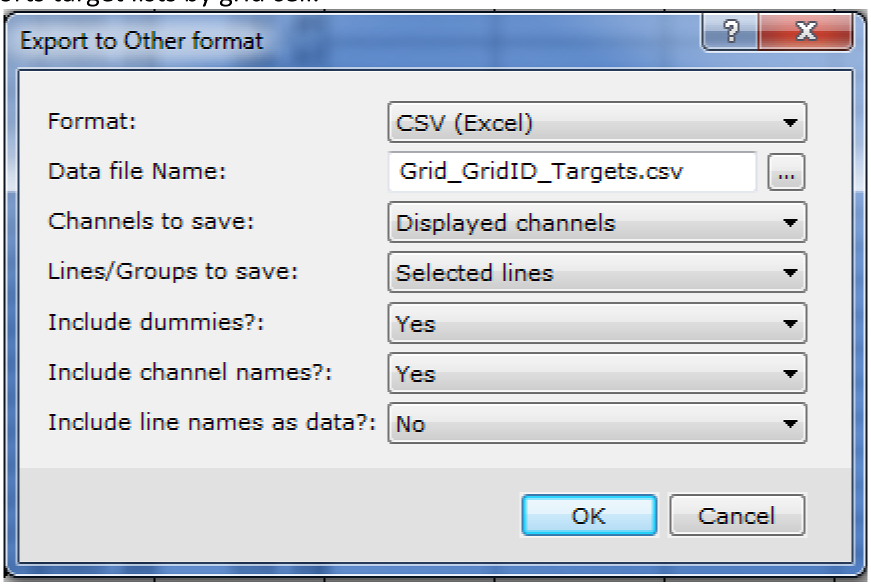
- Creates a pdf of the colored contoured grid cell map(s).
- Exports GeoTIFFs of colored contoured data



- Exports completed processed Geosoft xyz file with header information by dataset.



- Exports target lists by grid cell.



Prepare deliverables:

- Create a final delivery package that includes the following:
  - All the Geosoft colored contour grid cell maps that are in the dataset.
  - All the pdfs for the grid cell maps that are in the dataset.
  - Processed Geosoft gdb and xyz files of the dataset.
  - Geosoft grd files for the dataset
  - GeoTIFFs for the dataset
  - Target lists in xls format.

Fill out DGM processing form in the database.

3.5. QC of the Processed Data

Preliminary QC checks are as follows:

- Check that all deliverables have been prepared and are complete
- Check that DQOs are achieved and documented in the database.
- Check to see if leveling and lag corrections are appropriate.
- Check anomaly selections on the maps and target list files.
- Check maps title block, index map and legend (map & pdf).
- Check entries on the processing form in the database.

- Check that all forms have been filled out in the database, then create a Data Processing Report for submittal with the final deliverable.

4. Data Submittal and Archiving

Final processed data for QC function tests will be submitted by test (static, IVS, etc.) and date. Field data will be submitted by dataset. Each processed data submittal will include, at a minimum, the following:

- Final processed data in *.gdb and *.xyz formats
- Contoured geophysical data in *.map, *.pdf, and GeoTIFF formats
- Target list in *.xls format
- Data Processing Report in *.pdf format

All data submittal files will be compiled in a *.zip file and uploaded daily to the project ftp site. If more than one data processor is working on the project simultaneously, one individual will be designated to send an email to the appropriate parties listing the completed function test and field data for that day. A copy of the database updated with new data processing information will be transferred daily to the Field Data Manager who will merge it with the main copy of the database. Database management procedures are described in NAEVA SOP 4 (Data Management). Original copies of all raw and processed geophysical data will be housed on NAEVA's secure server which is backed-up daily and weekly.

5. References

Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP) Work Plan
EM 200-1-15 – Technical Guidance for Military Munitions Response Actions

6. Revision History

3-28-18 Initial publication after translation from NAEVA SOPs
4-13-18 Corrected minor typos and reworded for clarity

STANDARD OPERATING PROCEDURE DGM 03

Target Reacquisition

1. Purpose and Scope

The purpose of this Standard Operating Procedure (SOP) is to detail the procedures and operational methodologies associated with the marking and reacquisition of targets resulting from Digital Geophysical Mapping (DGM) in areas that are potentially contaminated with Munitions and Explosives of Concern (MEC). Equipment to be used includes the Geonics EM61-MK2 system(s) for the detection of metallic objects and the Trimble Real-Time Kinematic (RTK) Global Positioning Systems (GPS) for navigational positioning. Procedures outlined in this SOP will be conducted in accordance with the Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP).

2. Personnel, Equipment and Materials

This section describes the personnel, equipment and materials required to implement this SOP. The following individuals will be involved in the assembly and verification of the RTK GPS:

- Project Geophysicist
- Field Team Leader
- Quality Control (QC) Geophysicist
- Data Processor

The qualifications of the personnel implementing this SOP are documented in the QAPP Worksheet #4, 7 & 8.

3. Equipment and Theory

This SOP is applicable to the Geonics EM61-MK2 and Trimble RTK-GPS.

The Geonics EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. The Standard EM61-MK2 system consists of two air-cored coils, a digital data recorder, batteries and processing electronics. The EM61-MK2 functions by first having a transmitter that generates a pulsed primary electromagnetic field. This primary electromagnetic field then induces eddy currents in nearby metallic objects. The eddy currents produce a secondary electromagnetic field which then induces a secondary voltage inside the EM61-MK2 receiver coils that is measured at four distinct intervals (time gates) with measurements recorded in milliVolts (mV). The earlier time gates provide enhanced detection of smaller metallic objects while the later time gates provide for the identification of larger, more massive metal objects.

For this project the EM61-MK2 system will be operated in one of two positional modes; RTK-GPS and fiducial mode. The Trimble Real-Time Kinematic (RTK) GPS is a 24-channel dual frequency receiver that uses both L1 and L2 satellite frequencies that can maintain an accuracy of 1.2 inches (in) (3 centimeters (cm)) horizontal and 2 in (5 cm) vertical. This RTK system utilizes a GPS base station (base) that sends positional corrections to the GPS rover(s) via radio link.

4. Target Reacquisition Procedures

Target reacquisition will be performed using the same equipment (Geonics EM61-MK2) and positioning method (RTK-GPS or fiducial positioning) as was used during geophysical data collection. The instrument will be mounted on manufacturer-supplied wheels and operated by one person. The second team member will operate the RTK-GPS or assist the EM61-MK2 operator when GPS positioning is not used.

4.1. Instrument Setup

The instrument is set up according to the Geonics EM61-MK2 Manual. All cables are taped to the instrument to keep them from getting tangled and to minimize cable movement and reduce the potential for snagging vegetation. If the DGM data were collected using RTK-GPS positioning, the target locations are loaded onto the GPS controller in advance. In areas with fiducial DGM data positioning, target lists are printed out that list the local coordinates for each selected target.

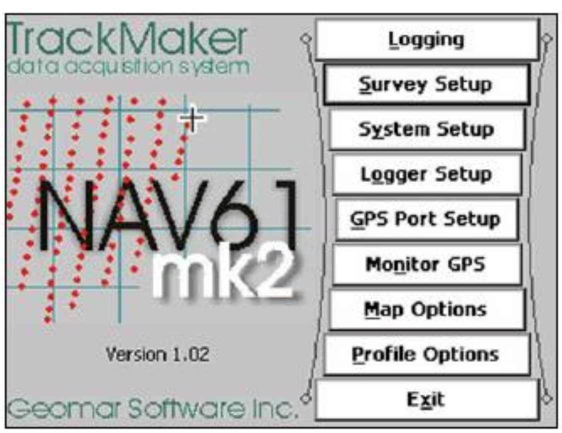
4.2. Navigation

Navigation to each selected target is accomplished through the use of RTK-GPS equipment or by using tape measures referenced to surveyed grid corners. If RTK-GPS is used, the base station is setup on a control point and corrections are sent via radio link to the rover receiver. The rover GPS antenna is mounted on a range pole and provides a visual reference of the distance and direction to the next selected target. Targets from DGM data with fiducial positioning are presented 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. A third tape measure is then pulled between corresponding marks on the first two tapes. The field team then marks all target locations within approximately 5 feet (ft) (1.5 meters (m)) of either side of the tape. The tape measure is then moved to the next location and the procedure is repeated until all targets in a grid have been marked. Regardless of the positioning method, all targeted anomalies will be marked in the field using a non-metallic pin flag labeled with the target ID.

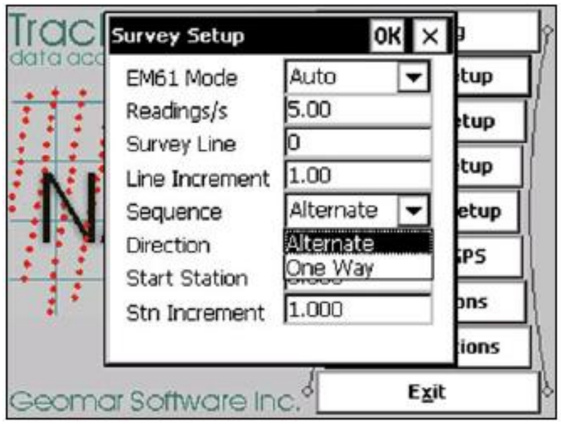
4.3. Reacquisition Steps

The following steps are followed to begin target reacquisition with the EM61-MK2:

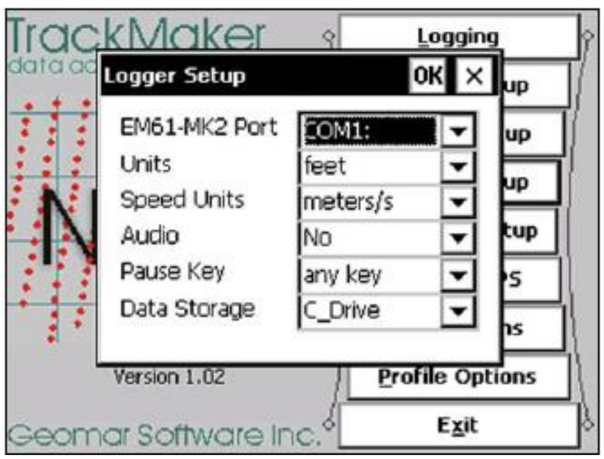
1. Turn on instrument by pushing in the fuse on the top of the console/electronics
2. Allow instrument to warm up for at least 15 minutes
3. Turn on Allegro CX and open NAV61MK2 program. The screen below will be displayed.



4. Click on "Survey Setup" and specify the below options. For target reacquisition, the Mode is set to "Auto" and Readings/s is set to "5".

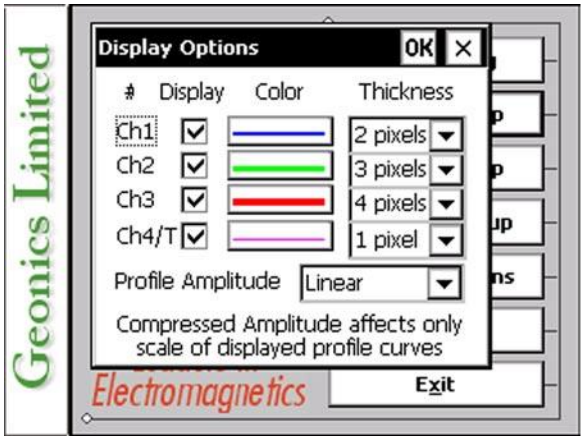


5. Click on "Logger Setup" and specify the below options. These setting will remain the same throughout the project.

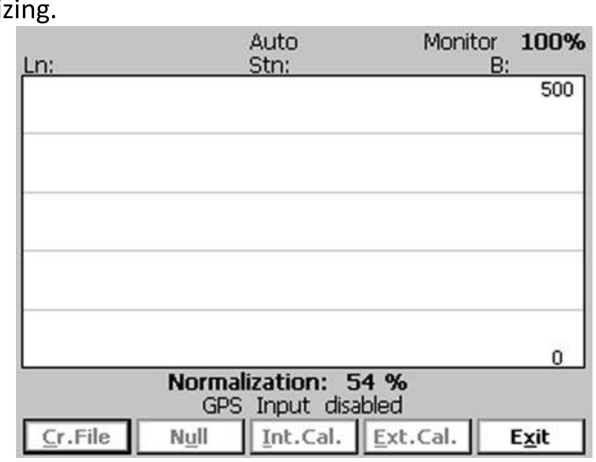


6. Click on "GPS Port Setup", and make sure the GPS Input is set to "Disabled", and all other options are grayed out.

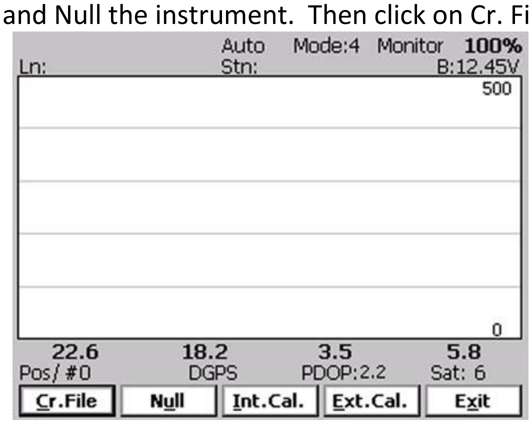
7. Click on "Display Options", and specify the following options. These options are also operator preferences for aesthetics and do not affect the collected data.



8. Once all parameters are set, click on "Monitor/Log". The screens shown below are displayed while the instrument is normalizing.



9. Once the Instrument has finished normalizing, find a quiet spot (area with low mV reading that is like that of the background) and Null the instrument. Then click on Cr. File and name and save the file.



10. Go to the first flagged location and search for the peak response by monitoring the values in the targeted channel on the Monitor/Log screen
11. Once the peak has been located, turn the instrument 90 degrees and look for the peak again. Each target will be checked in at least two perpendicular directions, but more orientations may be used at the operator's discretion.
12. Once the absolute peak has been identified, record the response from the targeted channel along with any offset from the original targeted location.
13. Move the pin flag to the new location and repeat this procedure at the next target.

5. Quality Control

The QC checks listed below are to be conducted after the instrument has been warmed up for at least 15 minutes. The QC function checks are to be conducted at the beginning and end of each day (unless otherwise noted) for each EM61-MK2 at a location that is known to be free of anomalous responses:

- GPS (if used) Static Positional Test
- Static Repeatability Test
- Cable Shake Test
- Personnel Test

Below is a description of each of the QC checks listed above. QC check data is to be digitally recorded, stored offsite, and reviewed by the data processor daily. The results of the daily QC checks are to be recorded in both the QC documentation and in the database.

1. GPS Static Positional Test (AM only): NAEVA will conduct static repeatability tests of their RTK-GPS antennas. This test will be completed at the beginning of each day at the IVS. The data for these GPS Static Positional Tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

2. Static Repeatability Test (AM and PM): NAEVA will conduct static repeatability tests (background and spike) for each person-portable system. These tests are to be completed twice daily at the IVS and will include 1 minute for background, 1 minute for spike, and 1 minute for an additional background reading. The baseline mV value for the static tests will be the average of AM and PM static tests conducted during the first week that the person portable system(s) is operational. The data for these static repeatability tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

3. Cable Shake Test (AM only): On a daily basis the EM61MK2 and GPS instrument cables will be tested to verify that cable vibrations do not have a negative effect on the quality of the data. The cable vibration test will be conducted at the beginning of each work day prior to the commencement of that day's operation. The data for these cable shake tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

4. Personnel Test (AM only): On a daily basis personnel operating the EM61-MK2 will be tested to verify that when in close proximity to the sensor that they do not have a negative effect on the quality of the data. This personnel test will be conducted at the beginning of each workday prior to

the commencement of that day's operation. The data for these personnel tests will be digitally recorded, observed in the field and results of these tests are to be documented on the geophysical contractor's daily internal Geophysical QC test form.

All QC checks will be digitally recorded and analyzed to verify that all data is within acceptable operational parameters as outlined in the UFP-QAPP.

6. References

Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP).
EM 200-1-15 – Technical Guidance for Military Munitions Response Actions.

7. Revision History

3-28-18 Initial publication after translation from NAEVA SOPs
4-13-18 Minor format changes and rewording for clarity

STANDARD OPERATING PROCEDURE DGM 04

EM61 Data Management

1. Purpose and Scope

The purpose of this Standard Operating Procedure (SOP) is to provide standardized procedures for the management and internal quality control (QC) of data gathered during field operations which is then cataloged and stored in the Microsoft Access field database (database). Procedures outlined in this SOP will be conducted in accordance with the Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP).

2. Scope

This SOP provides technical guidance on the daily gathering of field data as it relates to MMRP operations including, but not limited to: surveying of control points, brush removal (mastication), technology-aided surface MEC removal, digital geophysical mapping (DGM), data collection, target reacquisition, intrusive operations, demolition operations, QC, and quality assurance (QA). This document is not intended to contain all requirements needed to ensure the proper management of project data, but should be used in conjunction with the documents listed in the reference section below.

3. Responsibilities

NAEVA and TLI field staff are required to follow the procedures specified in this SOP during the performance of all field data management operations. The Data Manager is required to sign off that they have read and understand this SOP prior to beginning field work.

Database Manager Responsibilities

The primary method of collecting field data will be using tablet computers (Galaxy S4 or equivalent) assigned to each field team and pre-loaded with forms designed to capture all of the information pertinent to that activity. These forms are administered by the Data Manager using forms software. The form templates are stored on the Data Manager's computer where they are backed-up weekly to a remote server and can be assigned to the appropriate tablet for the day's planned activities. At the end of each field day, information gathered in the forms is synchronized directly to the database where it is immediately reviewed for accuracy and completeness by the Field Data Manager. In general, the Field Data Manager will be responsible for performing the following tasks on a daily basis:

- Verify time/date status on tables and distribute to field teams
- Perform tablet user proficiency training as necessary
- Updated status information in database, including control point surveys and brush removal (mastication)
- Assemble materials for grids that have moved to a new status (e.g. reacquisition completed grids to intrusive, intrusive completed grids to QC, etc.)
- Create updated forms for distribution to tablets at the end of the field day
- At end of day, receive all completed materials from field teams and synchronize tablets with Database
- Perform QC review of all new information received from field forms
- Merge new information received from off-site data processors and QC review of new information

- After completing all daily QC reviews, upload new copy of database to project FTP site (or similar location)
- Send email summary of daily progress to appropriate parties

4. Types of Data

The following data types listed below represent a sampling of the information that will be recorded on field tablet forms and otherwise incorporated into the database:

- Surveyor data may include coordinate information as it relates to geodetic monuments (permanent or temporary), boundaries, grid corners, cultural features, etc.
- Surface Clearance and/or Analog Investigation data may include (but are not limited to) anomaly information as it relates to MEC, MPPEH (Material Potentially Presenting an Explosive Hazard), MD (Munitions Debris) , OD (Other Debris), BSIs, or cultural items located during the investigation. Positional information may be in the form of GPS or local coordinates.
- DGM data may include (but are not limited to) function test (static, instrument verification strip [IVS], geodetic functionality) documentation, dataset ID, locations covered, surface conditions, weather, obstacles encountered, battery voltage, team and personnel ID, file names, and coordinate system.
- Data processing information may include (but are not limited to) data processor ID, data correction parameters (leveling, lag correction, filtering), EM61-MK2 channel selected for analysis, gridding parameters, target selection methodology including targeting threshold, and any comments that might prove helpful during the intrusive process.
- Reacquisition data may include (but are not limited to) anomaly information such as the unique ID, original location, offset from original location, reacquired response, and comments that might prove helpful during the intrusive process.
- Intrusive Investigation data may include (but are not limited to) anomaly information as it relates to MEC, MPPEH, MD, OD, BSIs, or cultural items located during the intrusive investigation. Positional information may be in the form of GPS or local coordinates.
- DGM related BSI data are to be recorded and initially managed by the Project Geophysicist. DGM related BSI data will not be made available to the Field Data Manager until after the QC Geophysicist has identified as to whether the DGM related BSI(s) match (or do not match) anomalies in the DGM target list. BSI information related to analog operations will be forwarded directly to Field Data Manager on a daily basis by the UXOQCS as they are installed. The Field Data Manager will safeguard the integrity of both the DGM and analog BSI information by keeping this BSI information external to the database and will not release it (except to USACE) until the investigation (surface sweep or intrusive) for that Unit has been completed and an assessment of the status of the BSIs has been made and documented by the QC staff.
- Other items to be tracked include inaccessible areas, and or other items of interest.
- QC information such as daily instrument test results, BSIs, Anomaly Resolution QC inspection results, geodetic equipment functionality, Geodetic Accuracy, etc.

5. Database Quality Control and Archiving

All data uploaded to the database will be reviewed for appropriateness, quality, and completeness by the Field Data Manager daily. After this initial QC review, the database will be uploaded to the project FTP site for both storage and to allow access to other project personnel. Appropriate QC personnel (UXO QC Specialist, Project Geophysicist, etc.) will also perform regular QC reviews and inspections of all aspects of the database that pertain to their specific roles. The Data Manager will be responsible for performing all database updates and edits requested by QC and QA personnel and by other project staff.

6. References

Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP)

EM 200-1-15 – Technical Guidance for Military Munitions Response Actions

7. Revision History

3-28-18 Initial publication after translation from NAEVA SOPs

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Appendix F2

EA MC Field SOPS

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Standard Operating Procedure No. 001
for
Sample Labels

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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Hunt Valley, Maryland 21031

Revision 1
November 2018

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 001	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	29 November 2018	Systematic review and update	Dan Hinckley Sheena Styger Sanita Corum	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the use of sample labels. Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. An example label is provided below. Other formats with similar levels of detail are acceptable. Some project software including Scribe (U.S. Environmental Protection Agency (EPA)-associated projects) and FUDSchem (U.S. Army Corps of Engineers-associated projects) can generate pre-prepared labels thus minimizing efforts in the field.

NOTE: It is important to review with the Project/Program Manager to determine if client or project-specific modifications to this SOP are required. For example, if using EPA laboratories, case numbers may be assigned in lieu of having site or project names on the label.

PROJECT NAME _____________ PROJECT NUM. ___________
SAMPLE LOCATION/SITE ID ____________________________
DATE: ____/____/____ TIME: _____:_____
ANALYTES: METALS VOC EXPLOSIVES ORGANICS OTHER
FILTERED: [NO] [YES]
PRESERVATIVE: [NONE] [HNO_3] [OTHER ______]
SAMPLER: ____________________

2. MATERIALS

The following materials may be required:

- Sample label
- Indelible marker.

3. PROCEDURE

The following sections describe how to use the sample labeling system.

3.1 LABEL INFORMATION

As each sample is collected/selected, fill out a sample label. Enter the following information on each label:

- Project name (do not include if there is a project or client-specific requirement to exclude)
- Project Number (or Case Number, as applicable)
- Location/site identification—enter the media type (i.e., well number, surface water, soil, etc.) sampling number, and other pertinent information concerning where the sample was taken
- Date of sample collection
- Time of sample collection
- Analyses to be performed (NOTE: Due to number of analytes, details of analysis should be arranged with laboratory *prior to start of work)*
- Whether filtered or unfiltered (water samples only)
- Preservatives (water samples only)
- Number of containers for the sample (e.g., 1 of 2, 2 of 2).

3.2 ROUTINE CHECK

Double-check the label information to make sure it is correct. Detach the label, remove the backing, and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

3.3 RECORD INFORMATION

Record the sample number and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated)
- Location of the sample
- Organic vapor meter or photoionization meter readings for the sample (when appropriate)
- Any unusual or pertinent observations (oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, etc.)
- Number of containers required for each sample

- Whether the sample is a quality assurance sample (split, duplicate, matrix spike/matrix spike duplicate, or blank).

3.3.1 Logbook Entry

A typical logbook entry might look like this:

- 7:35 a.m. Sample No. MW-3. Photoionization Detector = 35 parts per million.
- Petroleum odor present. Sample designated MW-3-001.

NOTE: Duplicate samples may be given a unique sample designation rather than the actual sample number with an added prefix or suffix. This will prevent any indication to the laboratory that this is a duplicate sample thus making it “blind” to the laboratory. This fictitious sample number must be listed in the logbook along with the actual location of the sample.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

If “blind” field duplicate samples have been called for, then no indication of which samples are duplicates is to be provided to the laboratory.

6. REFERENCES

Not applicable.

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Standard Operating Procedure No. 002
for
Chain-of-Custody Form

Prepared by

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Hunt Valley, Maryland 21031

Revision 1
November 2018

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 002	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	29 November 2018	Systematic review and update	Dan Hinckley, Sheena Styger, Sanita Corum	Matthew Bowman

1. SCOPE AND APPLICATION

A chain-of-custody record (attached) is used as physical evidence of sample custody and as a permanent record for each sample collected. A chain-of-custody record documents the exchange and transportation of samples from the field to the laboratory. The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for use of the chain-of-custody form. Three example forms are provided as Figures SOP002-1 (EA's standard electronic chain-of-custody form), SOP002-2 (EA's Toxicology Laboratory chain-of-custody form), and SOP002-3 (U.S. Environmental Protection Agency [EPA] Scribe chain-of-custody form). Other formats with similar levels of detail are acceptable.

Most EPA projects utilize sampling and chain-of-custody instructions as documented in EPA's Samplers Guide (2014), which includes the use of Scribe, an in-house software program used to establish computer records of all environmental data and includes generation of chain-of-custodies. Using Scribe requires training, and the software and guidance can be found at the following link: https://response.epa.gov/site/site_profile.aspx?site_id=ScribeGIS. Training on Scribe is necessary and can be obtained through the Scribe weblink.

All new U.S. Army Corps of Engineers projects require the use of Formerly Used Defense Sites chemistry database (FUDSchem), which can be found at the following link: http://fudschem.com/public/framework/bannerhtml.aspx?dsn=systm&idhtml=10642&themesuffix=default&banner=banner_fudschem.jpg. This software will generate chain-of-custody forms specific to the sampling session. As with Scribe, FUDSchem training is necessary.

It is essential that chain-of-custody forms be completed properly, and that sample relinquishment be signed and dated appropriately. Laboratories use chain-of-custodies as their statement of work and, if it is not correct, the samples will not be analyzed appropriately. Sample custody documentation assures that the particular samples have been in secure locations, and that none of them have been tampered with, thus assuring appropriate results.

2. MATERIALS

The following materials may be required: chain-of-custody form and indelible ink pen.

3. PROCEDURE

- Give the site name and project name/number.
- Enter the sample identification code.
- Indicate the sampling dates for all samples.
- List the sampling times (military format) for all samples.

- Enter the total number of containers per cooler.
- List the analyses/container volume.
- Obtain the signature of sample team leader.
- State the carrier service and airbill number, analytical laboratory, and custody seal numbers (if applicable).
- Sign, date, and time the "relinquished by" section. Be sure the carrier signs and enters dates and time of acceptance of the samples.
- Upon completion of the form, retain a copy or portable document format, and affix the laboratory copy to the inside of the sample cooler in a zip-seal bag to protect from moisture, to be sent to the designated laboratory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency (EPA). 2014. Sampler's Guide, Contract Laboratory Program Guidance for Field Samplers. EPA/540/R014/013, Directive 92400.2-147. October.

Figures

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Figure SOP002-1 EA Chain-of-Custody Form

Company Name:	Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis	Chain-of-Custody Record EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000
Project No. Dept.: Task:	Project Name:		
Sample Storage Location:	P.O. No.:		**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT:** __________
Page of	**Report No.:**		

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**														**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXXX																**LPM**:
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
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Company Name:	Project Manager or Contact: Phone:	Parameters/Method Numbers for Analysis	Chain-of-Custody Record EA Laboratories 231 Schilling Circle Hunt Valley, MD 21031 Telephone: (410) 584-7000
Project No. Dept.: Task:	Project Name:		
Sample Storage Location:	P.O. No.:		**Report Deliverables:** **1 2 3 4 D E** **EDD: Yes/No** **DUE TO CLIENT:** _________
Page of	**Report No.:**		

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**														**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																

Samples by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time	Airbill Number:	Sample Shipped by: (Circle) Fed Ex. Puro. UPS Hand Carried Other:

Cooler Temp. _______**C** **pH:** ___ **Yes** ___ **No** **Comments:** **Custody Seals Intact** ___ **Yes** ___ **No**

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

Figure SOP002-2 EA Toxicology Laboratory Chain-of-Custody Form

Client:	Project Manager: Phone:
	Project Contact: Phone:
Project Name: Project#:	
Page 1 of 1	

Sample Collected		Matrix		SAMPLE IDENTIFICATION	No. of Containers																							
Date	Time	Sediment	Water																									

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time

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Figure SOP002-3 EPA Scribe Chain-of-Custody Form

Page 1 of 1

USEPA
Lab Contact: John Smith
CarrierName: UPS
AirbillNo:
1Z2886820195095104

CHAIN OF CUSTODY RECORD
Site #: 47909
Contact Name: Michael Smith
Contact Phone: 800-332-0534

No: 5-112818-101859-0021
Cooler #: 13
Case #: 47909
Lab Phone: 800-660-1990

Lab #	Sample #	Location	Analyses	Matrix	Sample Date	Sample Time	Numb Cont	Container	Preservative	Lab QC
	HT18-01	HT18-01	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	
	HT18-02	HT18-02	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	
	HT18-03	HT18-03	MI 10 Metals + FE, NI 34PAHs, PCBs, TOC, Moisture	Sediment			1	8 oz amber	4 C	

Special Instructions:	SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt

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Standard Operating Procedure No. 003
for
Subsurface Utility Clearance

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 1
July 2018

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 003	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	6/28/2018	Systematic review and update	Matt Bowman	Pete Garger

1. SCOPE AND APPLICATION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to prevent injury to workers and damage to subsurface structures (including tanks, pipe lines, water lines, gas lines, electrical service, etc.) during ground disturbance activities (including drilling, augering, sampling, use of direct-push technologies, excavation, trenching, concrete coring or removal, fence post installation, grading, or other similar subsurface operations).

1.2 LIMITATIONS

The procedures set forth in this document are general guidance, but may not be entirely applicable to particular sites based on the site-specific considerations. The Project Manager is responsible for making a site-specific evaluation of each site to determine how subsurface utility clearance procedures should be utilized or modified. If safety or other site-specific considerations require a modified or different procedure, the Project Manager should review the modified procedure with the Business Unit Director, Profit Center Manager, or Senior Technical Reviewer. Evaluation support of modified procedures may be provided by the Corporate Health and Safety Director or the Lead Construction Quality Engineer.

Special considerations may be required for utility location activities at complex or challenging project sites (underwater utilities, hazardous waste sites, etc.). Additional subsurface utility clearance procedures should be added as appropriate for difficult sites. When health and safety risks to workers or potential utility damage cannot be effectively managed through utility location, clearance, and protection measures, the Project Manager must consider the modification of ground disturbance activities (e.g., establishing a safe offset from high risk utilities). In these cases, detailed coordination with the client and/or regulatory staff is likely required.

1.3 SCOPE

This SOP provides minimum guidance for subsurface utility clearance activities, which must be followed prior to and during ground disturbance activities at EA project sites. Even after completing the subsurface utility clearance activities required in this SOP, all ground disturbance activities should proceed with due caution.

Deviations from this SOP may be provided on an exception basis for specific situations, such as underground storage tank systems removals, verified aboveground/overhead services/lines, undeveloped land/idle facilities, shallow groundwater conditions, soil stability, or well construction quality assurance/quality control concerns, etc.

EA or its subcontractors are responsible for, and shall ensure that, all ground disturbance activities are completed safely, without incident, and in accordance with applicable federal, state, and local regulations.

This SOP shall not override any site-specific or consultant/contractor procedures that are more stringent or provide a greater degree of safety or protection of health or the environment.

2. PROCEDURES

The EA Project Manager or his/her designee must complete the Subsurface Utility Clearance Checklist (Attachment A) in conjunction with the following procedures. The checklist must be completed before initiating any ground disturbance activities. The completed checklist must be submitted to the appropriate team individuals, subcontractors, and/or the client and included in the project files.

2.1 SAFETY

A Health and Safety Plan must be available onsite and followed by all contractors and subcontractors.

Work areas should be defined and secured with safety cones, safety tape, construction fence, other barriers, or signs as appropriate.

Site work permits must be obtained as required by site procedures. Based on site conditions or classification, the use of intrinsically-safe equipment may be required.

To ensure the safety of all onsite personnel and subsurface structure integrity, consideration should be given to de-energizing and locking out selected site utilities or temporarily shutting down a portion of or the entire facility.

2.2 SUBSURFACE UTILITY LOCATION ACTIVITIES

To gather all relevant information about potential subsurface structures prior to ground disturbance activities, the project team should pursue multiple lines of evidence on the type, location, depth, size, material of construction, and status (active/abandoned) of all utilities within and near the area planned for ground disturbance activities. A minimum of three lines of evidence should be obtained and documented; however, additional lines of evidences should be secured when possible. Lines of evidence may include the following:

- Historical Site Information
- Public Utility Mark-Out (One Call – 811)
- Private Utility Mark-Out
- Site Inspection
- Client/Facility Interviews and Coordination.

2.2.1 Historical Site Information

The most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) should be obtained, as available.

NOTE: As-built drawings may not accurately depict the locations and depths of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

EA should obtain any other site information such as easements, right-of-ways, historical plot plans, fire insurance plans, tank (dip) charts, previous site investigations, soil surveys, boring logs, and aerial photographs, etc. as relevant to the planned ground disturbance activities. Where applicable, EA should also contact contract personnel who may have historical site knowledge.

2.2.2 Public and Private Utility Mark-Outs

EA must ensure that a thorough mark-out at the site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and all other subsurface utilities/services.

- Where available, public utility companies must be contacted to identify subsurface utilities. (This can be accomplished through the One-Call system in most instances.) Attachment B provides a brochure for the 811 Utility Locate Call Center.

- In addition, where available and warranted by site conditions, a private utility/pipeline mark-out company should be contracted to perform an electronic subsurface survey to identify the presence of suspected hazardous or critical subsurface utilities and structures. In some cases, this is necessary to confirm public utility mark-outs in the vicinity of planned ground disturbance activities.

EA will review all available site plan subsurface information with the private mark-out company to assist in locating utilities and other subsurface structures.

NOTE: Mark-outs may not accurately depict the exact locations of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

Where possible, EA personnel are encouraged to be onsite at the time of subsurface mark-outs. This is to ensure accuracy and understanding of subsurface utility structures identified and provides an opportunity to exchange information with mark-out company personnel regarding planned work activities.

Subsurface utility structures should be marked throughout the entire work area(s) with adequate materials (e.g., site conditions may require paint and tape/flags). Ground disturbance activities must be started within 30 days of mark-out, unless local ordinances specify a shorter time period.

If activities are not started within required time period or markings have faded, mark-outs must be redone.

EA personnel will record time and date of mark-out request and list all companies contacted by the service and confirmation number. This information should be available for review onsite and checked off after visual confirmation of markings.

2.2.3 Site Inspection

To compare the site plan to actual conditions based on information gathered in other lines of evidence, a site inspection should be performed to identify potential signs of subsurface utilities. These signs may include:

- Signage identifying subsurface utilities
- Asphalt patching or paving scars
- Pull boxes, junction boxes, valve box covers, or manhole covers
- Sewer drains and clean-out traps
- Meters and light poles
- Piping or conduit on the walls or roofs of buildings
- Linear ground depressions
- Markings from previous utility mark-out efforts
- Other utilities including fire hydrants, on/below grade electrical transformers, splice cages, sprinkler systems, steam lines (including insulated tanks that may indicate steam lines), and cathodic protection on lines/tanks.

EA will document all findings and update the site plan with this information. In some regions, it may be more effective and efficient to conduct the site inspection at the same time the contractor performing the ground disturbance activity is mobilized to the site. The site inspection may include others as determined by the consultant/contractor and the Project Manager.

2.2.4 Client/Facility Interviews and Coordination

Knowledgeable client and facility staff familiar with site utilities should be interviewed to obtain information and documentation on potential subsurface utility locations, depth, etc. Results of these interviews should be documented and included with the Subsurface Utility Clearance Checklist. On third party sites, close coordination with the site owner's representatives for mark-outs, review of as-builts, and other information reviews should be conducted prior to any ground disturbance work. Project Managers are encouraged to provide updated as-built information to the client.

EA will review the selected ground disturbance locations with the client. EA will not proceed with the subsurface activities until the plan has been discussed with the client. During execution of the project, if subsurface activities are required outside of the area previously approved by the client, EA will submit these changes to the client for approval prior to execution.

2.2.5 Ground Disturbance Activity Sequence

When practical, EA will plan ground disturbance activities starting at the point farthest from the location of suspected underground improvements. This is done to determine the natural subsurface conditions and to allow EA site personnel to recognize fill conditions.

Experience has shown that the following warning signs may indicate the presence of a subsurface structure:

- Warning tape (typically indicative of underground services).
- Pea gravel/sand/non-indigenous material (typically indicative of tanks or lines).
- Red concrete (typically indicative of electrical duct banks).
- The abrupt absence of soil recovery in a hand auger. This could indicate pea gravel or sand that has spilled out of the auger. This may not be indicative in areas where native soil conditions typically result in poor hand auger recoveries.
- Any unexpected departure from the native soil or backfill conditions as established by prior onsite digging.

If any of these conditions is encountered by EA site personnel, digging should stop and the client should be contacted.

3. UTILITY PROTECTION MEASURES DURING GROUND DISTURBANCE ACTIVITIES

After mobilization, but prior to the primary ground disturbance activities, the physical location of subsurface utilities should be cleared and verified whenever possible and practical. The clearance method used to clear and verify the subsurface utilities should be compatible with the inherent associated risk given the type of facility/property, subsurface utility material of construction, utility depth, soil stratigraphy, and the location of the ground disturbance activity, such that required delineation is obtained. It should be noted that in areas where there is paving, sufficient paving should be removed to allow clear visibility of the subsurface conditions during clearance activities. The following is a list of potential clearance methods that may be used on a job site:

- Vacuum digging
- Probing
- Hand digging
- Hand augering
- Post-hole digging.

EA personnel will evaluate the potential for electrical shock or fire/explosion for each subsurface disturbance project and will evaluate as necessary the use of non-conductive or non-sparking tools (i.e., fiberglass hand shovels, and thick electrically insulating rubber grips on hand augers or probes). The potential need for the use of non-conductive materials, electrical safety insulated gloves, and footwear will also be evaluated on a case-by-case basis.

For drilling, direct-push technology, fence post installation, or other borehole installation, the area to be delineated will exceed the diameter of the largest tool to be advanced and sufficiently allow for visual inspection of any obstructions encountered.

3.1 SUBSURFACE CLEARANCE PROCEDURES FOR TRENCHING/ EXCAVATION ACTIVITIES

For trenching and excavation activities, appropriate subsurface clearance methods should be conducted along the length and width of the excavation at a frequency sufficient to ensure adequate precautions have been applied to the entire work area. The frequency and density of investigations will be based on site knowledge, potential hazards, and risks of the work area to surrounding locations.

Whenever subsurface structures are exposed, EA will cease work and mark the area (e.g., flags, stakes, cross bracing) to ensure the integrity of these exposed structures is maintained during subsequent trenching/excavation/backfilling.

During ground disturbance activities, EA and its subcontractors should consider the use of spotters to monitor the excavation for signs of subsurface utilities (pipes, conduits, cables, bedding material, warning tape, tracing wire, soil material changes, etc.) to provide early warning in the event unknown subsurface utilities are encountered. The decision to use spotters should be based on the risk of encountering unknown subsurface utilities, utility hazards associated potential unknown utilities that could be encountered (electrical, natural gas, etc.), and the physical and environmental hazards to have a spotter in proximity to the excavation. Spotters, if used, should be briefed on the potential physical and utility hazards that may be present at the site and the signs of subsurface utilities that they should be monitoring for during ground disturbance activities.

Uniform color codes for marking of underground facilities are provided in Attachment C.

Attachment A

Subsurface Utility Clearance Checklist

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SUBSURFACE UTILITY CLEARANCE CHECKLIST

Site Identification: ______________________________

Project Consultant/Contractor: ______________________________

Section 1: Safety, Preparation Tasks, and Mark-Outs

Activity	Yes	No	N/A	Comments including Justification if Response Is No or Not Applicable
Health and Safety Plan is available and all contractors and subcontractors are familiar with it.				
All applicable local, state, and federal permits have been obtained.				
Site access/permission has been secured.				
Most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) obtained.				
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, rights-of-way, historical plot plans, fire insurance plans, tank dip charts, previous site investigations, soil surveys, boring logs, aerial photographs, etc.).				
Utility mark-outs have been performed by public utility company(s). Mark-outs clear/visible.				
Subsurface structure mark-outs performed by private mark-out company. Mark-outs clear/visible.				
Additional Activities: Were dig locations reviewed with site representative?				

Section 2: Initial Site Visit and Selecting Ground Disturbance Locations

Activity	Yes	No	N/A	Comments, including Justification if Response Is No or Not Applicable
Location of all aboveground indicators of subsurface utilities/services that may be leading to or from buildings within the planned work area has been identified.				
Location of utility mark-outs by all utility companies previously contacted has been identified within required time period.				
Location of all subsurface structure mark-outs by private mark-out company has been identified within required time period.				
Location of area lights/signs and associated subsurface lines identified.				
Location of all phones and associated subsurface lines identified.				
Location of all drains and associated interconnecting lines identified.				
Location of all electrical junction boxes and associated interconnecting lines identified				
Location of all natural gas meters or connections and all interconnecting lines identified				

Completed by: ______________________________
Name

Signature: ______________________________ ______________
Company Date

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Attachment B

811 Utility Locate Brochure

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ALWAYS CALL BEFORE YOU DIG

One free, easy call gets your utility lines marked AND helps protect you from injury and expense.

Know what's below. Always call 811 before you dig.
Visit call811.com for more information.

811 Know what's below. Call before you dig.

INSERT CALL CENTER LOGO HERE

U.S. Department of Transportation

The Associated General Contractors of America — Building Your Quality of Life

John Deere

Travelers

Common Ground Alliance

Know what's **below.** **Call** before you dig.

Q: WHAT IS 811?

A: 811 is a new federally-mandated N-11 number designated by the FCC to consolidate all local "Call Before You Dig" numbers and help save lives by minimizing damages to underground utilities. One easy phone call to 811 quickly and easily begins the process of getting underground utility lines marked. Local One Call Center personnel will then notify affected utility companies, who will continue to mark underground lines for free.

Q: WHY SHOULD I CALL 811 BEFORE EVERY DIG?

A: Calling 811 will help save lives and protect infrastructure. Knowing where underground utility lines are buried before each digging project begins helps protect you from injury, expense and penalties. The depth of utility lines varies and there may be multiple utility lines in the same area. Even simple digging projects can damage utility lines and can disrupt vital services to an entire neighborhood, harm diggers, and potentially result in expensive fines and repair costs. Marked lines show diggers the approximate location of underground lines and help prevent undesired consequences.

Q: I'M JUST A HOMEOWNER, NOT A CONTRACTOR—IS 811 FOR ME?

A: Calling 811 is for professional excavators and do-it-yourself homeowners. A recent national survey revealed that roughly half of Americans are "active diggers" who have done (or are planning to do) some type of digging project at home. Whether you are a professional excavator or an avid do-it-yourselfer, you need to call 811 before every dig every time.

Q: WHO IS PROMOTING AWARENESS OF 811?

A: The national 811 campaign is a project of The Common Ground Alliance (CGA), working with its 1,400 individual members, member organizations, sponsors and 811 campaign national launch partners. CGA is a member-driven association dedicated to ensuring public safety, environmental protection, and the integrity of services by promoting effective damage prevention practices. In recent years, the association has established itself as the leading organization in an effort to reduce damages to all underground facilities in North America through shared responsibility among all stakeholders.

Attachment C

Uniform Color Codes for Marking of Underground Facilities

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APWA UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

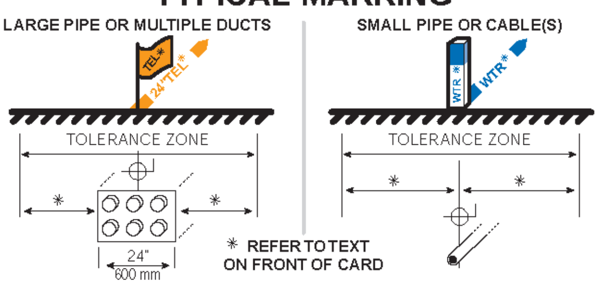
ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewers and Drain Lines

TYPICAL MARKING



Customize with your center's phone and address information

GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

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Standard Operating Procedure No. 004
for
Sample Packing and Shipping

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 1
September 2018

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**also check Box A**), or if this SOP is being used with no changes (**only check Box B**).

☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 004	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	25 September 2018	Systematic update and review	Cristina Radu, Amanda Kohn	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the packing and shipping of environmental samples to the laboratory for analysis. Additional requirements are applicable when shipping samples under the U.S. Environmental Protection Agency's Superfund Contract Laboratory Program.

NOTE: Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated could require shipment as dangerous goods; procedures for shipping of such samples are not covered in this SOP.

2. MATERIALS

The following materials may be required:

- Clear tape
- Custody seals
- Ice
- Packing material
- Plastic garbage bags
- Sample documentation
- Waterproof coolers (hard plastic)
- Zip-seal plastic bags.

3. PROCEDURE

Refer to SOP Numbers (Nos.) 001, 002, 016, and 039 as applicable.

Samples will be placed in clean, bubble-wrap lined sample coolers with double-bagged ice immediately after collection to ensure proper preservation. Most sample analyses require that the sample material is maintained at 2-6 degrees Celsius (°C). It is also important to ensure that sample containers are maintained at all times at the temperature required by the analytical method used to analyze the sample media; as such, samples should be retained in a chilled cooler during the inventory, quality control, and packaging process.

Check cap tightness and wipe down outside of each sample container. Verify that information on sample labels is correct and matches chain-of-custody forms. Ensure that both waterproof labels and indelible ink are used to label sample containers. Clear tape should be placed completely over the label. Wrap breakable sample containers in bubble wrap. Enclose each sample in a clear zip-seal plastic bag.

Prepare cooler for shipping. Empty any water that has accumulated in coolers from melting ice. Securely seal all valves and/or drain holes in the shipping container, both inside and out, with duct tape to prevent leakage in the event of sample container breakage or melting ice. Place several layers of bubble wrap on top of absorbent material and line the cooler sidewalls with bubble wrap. Line cooler with open garbage bag.

Prepare sample containers for shipping as follows:

- ***Glass Containers***—Wrap each glass sample container in bubble wrap or closed cell foam sheets. It is acceptable to package up to three 40-milliliter vials in one bubble wrap bag that is usually provided by the analytical laboratory. Enclose sample containers in a clear zip-seal plastic bag.

- ***Polyethylene Containers***—Place sample containers in clear zip-seal bags.

- ***Zip-Seal Bags***—Double-bag the samples to ensure that moisture will not reach the label.

Place all the sample containers upright inside garbage bag. Do not stack glass containers or lay them on their sides. Add additional bubble wrap between and around sample containers as needed to ensure containers do not shift during transport. If a second garbage bag was used, tie the (inner) garbage bag to isolate samples.

Double bag and seal loose, fresh ice to prevent melting ice from soaking the packing material. Fill gallon-size or larger zip-seal bags with fresh ice about two-thirds full and squeeze excess air out of the bags before sealing. Turn bag upside down and place in a second zip-seal bag, also removing excess air. Prepare sufficient bags to cover sample containers and ensure that the proper temperature (2-6° C) is maintained during transport.

Place ice on top of sample containers. Ensure that packing material does not insulate samples from ice. Do not use loose ice in sample coolers. Do not use bagged ice as packing material between or around sample bottles. Tie the garbage bag ensuring that the cooler lid will close securely.

Place a temperature blank into the cooler. The temperature blank consists of a plastic bottle containing either potable or deionized water. Temperature blanks are typically provided by the analytical laboratory. If temperature blanks are not provided, field staff must add a clean container filled with deionized water; ensure the cap is tight and container is labeled before placing in cooler.

If aqueous volatile organic analyte samples are being submitted, ensure a trip blank sample set is placed in each cooler containing volatile organic analyte samples. Trip blanks are used to check for contamination of volatile organic compound samples during handling, storage, and shipment from field to laboratory. The trip blanks consist of volatile organic analyte vials filled with deionized water and are typically provided by the analytical laboratory. Ensure that the trip blank samples and analyses are included on the chain-of-custody record.

Make copies of sample documentation (chain-of-custody forms or other field records) and retain in field files for record. Enclose the original field documentation forms in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.

Seal coolers with signed and dated custody seals such that if the coolers were opened, the custody seals would be broken. Place clear tape over the custody seals to prevent damage to the seals.

Tape the cooler shut with packing tape over the hinges and custody seals. Tape should be wrapped around the cooler a minimum of five times. Ship all samples via overnight delivery on the same day they are collected if possible. Project-specific shipping requirements (e.g., Saturday delivery, communication with the receiving laboratory, etc.) should be discussed with the sample manager or project manager during project planning.

After samples are packaged within shipping containers, place shipping labels clearly on the outside of the container; clearly mark the number of containers in the shipment on the shipping label. Mark each cooler as “1 of 2,” “2 of 2,” etc.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

The project manager and field team leader are responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample meets or is suspected to meet the definition of “dangerous goods” per the Dangerous Goods Regulation of the International Air Transport Association, then that sample must be handled according to the instructions given for that material. Dangerous goods must be prepared for shipping only by personnel trained and certified by International Air Transport Association in dangerous goods shipment.

6. REFERENCES

Not applicable.

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Standard Operating Procedure No. 005
for
Field Decontamination

Prepared by

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Revision 2
September 2018

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PROJECT-SPECIFIC VARIANCE FORM

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☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

SOP No. 005	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	25 September 2018	Systematic update and review	Cristina Radu, Amanda Kohn	Matthew Bowman

1. SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling, or that enter a hazardous waste site, must be thoroughly decontaminated prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. This Standard Operating Procedure (SOP) describes the normal decontamination of sampling equipment and site personnel. Specific projects and programs may have additional decontamination requirements. Refer to the planning document(s) for additional site-specific requirements.

As a good practice, sampling at a site should be conducted moving from least to most impacted locations to minimize the potential for cross-contamination. It is advisable to use disposable tools and personal protective equipment to the extent possible such that decontamination is not necessary. If disposable equipment cannot be used, all attempts will be made to minimize the need for decontamination by using dedicated equipment when practical.

1.1 MATERIALS

The following materials may be required:

0.01 normal (N) hydrochloric acid	Non-phosphate laboratory detergent (Liquinox)
0.10 N nitric acid	Plastic garbage bags
Aluminum foil or clean plastic sheeting	Plastic sheeting, buckets, etc. to collect washwater and rinsates
Approved water (deionized, potable, etc.)	Pressure sprayer, spray bottles, brushes, laboratory wipes, disposable cloth (shop towel or similar)
High performance liquid chromatography (HPLC)-grade water[a]	Reagent grade alcohol[b]

a. For the purpose of this SOP, HPLC-grade water is considered equivalent to "deionized ultra-filtered water," "reagent-grade distilled water," and "deionized organic-free water." The end product is water that is pure with no spurious ions or organics to contaminate the sample. The method of generation is left to the individual contractor.
b. For the purpose of this SOP, the term "reagent grade alcohol" refers to either pesticide grade isopropanol or reagent grade methanol.

1.2 PROCEDURE

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination procedures are conducted in the Contaminant Reduction Zone, which may or may not be contiguous to the Exclusion Zone. The Contaminant Reduction Zone should be located on a level, preferably paved surface, either in an area upwind of the investigation/sampling area or in an area believed to be free of surface contamination. Care must be employed when moving contaminated tools and equipment to the Contaminant Reduction Zone to prevent the spread of contamination.

Specially designated and properly built decontamination pads may be built at a centralized location to accommodate larger pieces of equipment. The pads are built such that any water produced during the decontamination process can be contained and pumped into investigative-derived waste holding containers (i.e., frac tank, 55-gallon drum, etc.) for waste profiling and disposal.

For other field equipment, the Contaminant Reduction Zone may be a mobile decontamination station set up in the vicinity of the Exclusion Zone or sampling location. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

1.2.1 Sample Bottles

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Ensure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

1.2.2 Personnel Decontamination

Review the Health and Safety Plan for the appropriate decontamination of site personnel and reusable personal protective equipment, such as protective suits used at highly contaminated sites, respirators, safety boots, safety glasses, etc. Decontamination will be conducted in a designated Contaminant Reduction Zone as per the Health and Safety Plan and the general decontamination procedures outlined further in this SOP.

1.2.3 Non-Dedicated Equipment

Reasonable attempts will be made to minimize the need for decontamination by using dedicated equipment when practical.

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination shall be conducted at a central decontamination station (i.e., decontamination pad) or at the sampling location.

Decontamination stations should be located on a level, preferably paved surface, either in an area upwind of the investigation area or in an area believed to be free of surface contamination. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

Used decontamination solutions will be disposed of properly according to the site-specific Health and Safety Plan or applicable planning documents.

1.2.3.1 Field Monitoring and Testing Equipment

Water quality meters and temperature, pH, conductivity, redox, and dissolved oxygen probes will be cleaned per the manufacturer's instructions. If no such specifications exist, remove gross contamination and triple rinse probe with HPLC-grade water. If downhole probes are used, wipe the wetted portion of the cable with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination and rinse with approved water.

Electronic water level indicators, weighted tapes, measuring tapes transducers, level loggers, etc. will be decontaminated after each use as follows:

- Wipe the wetted or contaminated portion of the tape or cable and the probe with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination. Rinse cloth in the solution and continue wiping until tape or cable is clean.

- Wipe with a second wipe or cloth or rinse with HPLC-grade water to remove soap residue.

- Dry tape with a third cloth (or laboratory wipe) and rewind into case or on spool, or re-coil tape.

Other field monitoring or measuring equipment such as beakers and graduated cylinders used to measure flow rates; flow-through cells used for monitoring water quality parameters; piezometers used to determine water levels; packers, mechanical slug device, and downhole equipment used during aquifer (hydraulic) testing; etc. will be decontaminated by washing with a non-phosphate laboratory detergent solution, followed by approved water and HPLC-grade water rinse.

1.2.3.2 Bladder Pumps

Non-dedicated bladder pumps with disposable bladders will be decontaminated as follows:

- Disconnect tubing from pump.

- Completely disassemble the pump, being careful to note the initial position of and retain any springs and loose ball checks.

- Discard the pump bladder.

- Clean all parts in the same manner as provided in Section 1.2.3.1.

- Install a new Teflon® bladder and reassemble pump.

- Store pump in a clean, dedicated polyvinyl chloride, polytetrafluorethylene (PTFE), or low density polyethylene (for perfluorooctanesulfonic acid/per- and polyfluoroalkyl substances sampling) storage container.

1.2.3.3 Grundfos Redi-Flow® or Similar Submersible Pumps

Non-dedicated Grundfos Redi-Flow® and similar pumps will be disassembled and decontaminated per the manufacturer's instructions on an as-needed basis (i.e., where high concentrations and an elevated risk of cross-contamination exist). Due to the challenges associated with pump decontamination, if possible, consider designating one pump for sampling in highly contaminated areas and a second pump for sampling non-impacted areas or areas with lower contaminant concentrations. In most cases, the pumps will be decontaminated following the procedures below.

The pump and support cable/electrical wires that come in contact with water will be decontaminated via pumping as detailed below. To avoid electrical shock, always disconnect power from the pump when handling the pump body during decontamination procedures.

- Disconnect sample tubing from pump.

- Decontaminate the wetted portion of the cable/electrical wires by washing with non-phosphate laboratory detergent solution, followed by approved water and HPLC-grade water rinse. Coil cable/electrical wires on spools or clean plastic sheeting.

- Scrub the exterior of the pump to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate detergent (steam cleaning may be substituted for detergent scrub).

- Transfer pump to rinse bucket filled with approved water. Rinse by pumping no less than nine volumes or a minimum of 5 minutes of approved water.

- Rinse pump exterior with reagent grade alcohol.

- Rinse pump exterior with HPLC-grade water.

- Rinse pump exterior with 0.10 N nitric acid solution

- Rinse pump exterior with HPLC-grade water.

- Allow pump to air dry.

- Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride or PTFE storage container.

- Prior to reusing pump, rinse exterior again with HPLC-grade water.

1.2.3.4 Other Liquid Sampling Equipment

Other sampling equipment used to collect surface water, groundwater, non-aqueous phase liquid (NAPL), or other liquid samples includes but is not limited to PTFE double-check valve bailers, dip samplers (whether bucket, long-handled, or short-handled), discrete interval stainless-steel samplers, ball check valves and foot valves, and labware (i.e., beakers, graduated cylinders, vials, and other containers that are used to hold samples for field measurements/screening and water chemistry). This equipment will be decontaminated after each use as follows:

- Discard all ropes, tubing, etc. used in sampling in a properly marked sealable container, or as directed by the Health and Safety Plan. NOTE: No tubing is to be used in conjunction with a bailer in collecting samples.

- Wash sampling equipment with non-phosphate laboratory detergent and approved water solution using appropriate brush(es), laboratory wipes, or disposable cloth (shop towel or similar) to remove gross (visible) contamination.

- Rinse with approved water.

- Rinse with reagent grade alcohol.

- Rinse with HPLC-grade water.

- Rinse with 0.10 N nitric acid solution using a spray bottle. This rinse may be eliminated if inorganic compounds such as metals are not being sampled/are not a contaminant of concern.

- Rinse with HPLC-grade water.

- Allow equipment to air dry. If sampling equipment has just been used for purging and is being decontaminated prior to sampling, do not air dry. Double rinse with HPLC-grade water and proceed to collect samples.

- Wrap equipment in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride or PTFE storage container.

- Rinse equipment with HPLC-grade water immediately prior to re-use.

1.2.3.5 Solid Materials Samplers

Solid materials samplers include soil and sediment sampling probes, augers, trowels, shovels, sludge samplers, and other sampling equipment (e.g., core tubes, grab samples, core catchers, core liners, scoops, spoons, etc.), which will be decontaminated as follows:

- Scrub the sampler to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent (steam cleaning may be substituted for detergent scrub).
- Rinse off detergent with approved water.
- Rinse sampler with reagent grade alcohol.
- Rinse sampler with HPLC-grade water.
- For non-metallic samplers only, rinse sampler with 0.10 N nitric acid solution.
- For non-metallic samplers only, rinse sampler with HPLC-grade water.
- Allow sampler to air dry.
- Wrap sampler in aluminum foil or clean plastic sheeting, or store in a new zip-seal bag (size permitting) or clean, dedicated polyvinyl chloride or PTFE storage container.
- Rinse sampler with HPLC-grade water immediately prior to re-use.

For larger sediment sampling equipment, if sediment can be collected from the interior of a sampling device and away from potentially contaminated surfaces of the sampler, a site water rinse may be sufficient between stations. A site water rinse may also be sufficient for vessel surfaces between sample locations. However, all tools and equipment coming into contact with the sample should be decontaminated in accordance with the procedures above. Washwater from decontamination activities should be collected and disposed of properly.

1.2.3.6 Other Sampling and Measurement Probes

Soil (or sediment) gas sampling probes will be decontaminated as solids sampling devices.

1.2.3.7 Drilling Rigs, Sediment Sampling Vessels, and Other Heavy Equipment

All drilling rigs, sediment sampling vessels, and associated equipment such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out) will be decontaminated prior to site entry after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed prior to site entry when there is a likelihood that contamination has accumulated on tires and as spatter or dust on the way from one site to the next.

- Place contaminated equipment in an enclosure (i.e., existing wash pad, decontamination pad, etc.) designed to contain all decontamination residues (water, sludge, etc.).

- Steam clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) have been removed.

- Water used will be taken from an approved source.

- Containerize decontamination fluids in 55-gallon drums; sample; characterize; and, based on sample results, dispose of all decontamination residues properly.

Other heavy equipment includes use of backhoes, excavators, skid steers, etc. If heavy equipment is utilized during field activities (i.e., a backhoe for test pitting), the bucket should not come in contact with soil to be sampled. If the bucket contacts the soil to be sampled, then it should be decontaminated between sample locations, following the same procedures as listed above for a drill rig.

1.2.3.8 Ice Chests and Reusable Shipping Containers

Scrub exterior/interior with approved brush and Liquinox detergent. Rinse off detergent with approved water. Let air dry and properly store until re-use.

NOTE: If container/ice chest is severely contaminated, clean as thoroughly as possible, render unusable, and properly dispose of.

2. PRECAUTIONS

Segregate all waste streams as specified in the sampling documents and store investigation-derived waste properly. Dispose of all washwater, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed by the Health and Safety Plan or applicable planning documents.

Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

3. REFERENCES

Site-specific Health and Safety Plan and/or applicable planning documents.

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Standard Operating Procedure No. 015
for
Document Control System

Prepared by

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Revision 0
December 2014

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for identifying and storing a complete set of documents relating to project tasks. Each document will receive a unique identification number comprised of elements describing the document.

2. MATERIALS

Not applicable.

3. PROCEDURE

Each project-related document will be given to the Document Control Officer. The Document Control Officer will record information for each document on a Document Control Sheet which will be retained as a backup record. The information from each Document Control Sheet will be maintained in a computer database.

The individual Document Control Number will be entered on the Document Log Sheet and will be written on the document.

The storage location for each document will be recorded on the Document Control Log Sheet and the documents will be stored in the recorded location.

The database file will be backed up on a regular basis to prevent accidental loss of the data.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

None.

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Standard Operating Procedure No. 016
for
Surface Water, Groundwater, and Soil/Sediment Field Logbooks

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Revision 0
December 2014

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for recording surface water, groundwater, soil/sediment sampling information, instrument calibration data, and data from hydrologic testing in the field logbooks. Acceptable field logbooks are: bound, unprinted books such as a surveyor's field book, or a federal supply service No. 7530-00-222-3525 record book (or equivalent); or they may be company-proprietary, pre-printed forms bound into a field logbook. Example forms are provided herein. Alternate, equivalent forms are acceptable.

2. MATERIALS

The following material may be required: applicable field logbook and indelible ink pen.

3. PROCEDURE

Information pertinent to soil/sediment, groundwater, or surface water sampling will be recorded in the appropriate logbook. Each page/form of the logbook will be consecutively numbered. Entries will be made in indelible ink. Corrections will consist of line-out deletions that are initialed and dated. If using carbon paper or self-duplicating forms, before entering data in logbook, insert a sheet protector between form sets to isolate first blank form from remaining forms.

3.1 SOIL/SEDIMENT LOGBOOK (Requires Figures SOP016-1 and SOP016-3)

3.1.1 Field Parameter Form (Items on Figures SOP016-1 and SOP016-2)

1. HIGH CONCENTRATION EXPECTED?: Answer "Yes" or "No."

2. HIGH HAZARD?: Answer "Yes" or "No."

3. SITE: Record the complete name of the site.

4. AREA: Record the area designation of the sample site.

5. INST CODE: Record the 2-letter installation code appropriate for the installation or site. Correct abbreviations can be found on Pages 3-6 of the IRDMS User's Guide for chemical data entry.

6. FILE NAME: Record "CSO" for a soil sample or "CSE" for a sediment sample.

7. SITE TYPE: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry. This entry must match the Site Type on the map file form.

8. SITE ID: Record a code up to 10 characters or numbers which is unique to the site.

9. FIELD SAMPLE NUMBER: Record a code specific for the sample.

10. DATE: Enter the date the sample was taken.

11. TIME: Enter the time (12-hour or 24-hour clock acceptable as long as internally consistent) the sample was taken.

12. AM PM: Circle "AM" or "PM" to designate morning or afternoon (12-hour clock).

13. SAMPLE PROG: Record "GQA" (Groundwater Quality Assessment) or other appropriate sample program.

14. DEPTH (TOP): Record the total depth sampled.

15. DEPTH INTERVAL: Record the intervals at which the plug will be sampled.

16. UNITS: Record the units of depth (feet, meters)

17. SAMPLE MEASUREMENTS: Check the appropriate sampling method.

18. CHK: Check off each container released to a laboratory.

19. ANALYSIS: Record the type of analysis to be performed on each sample container.

20. SAMPLE CONTAINER: Record the sample container type and size.

21. NO.: Record the number of containers.

22. REMARKS: Record any remarks about the sample

23. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: Record the total number of containers.

24. SITE DESCRIPTION: Describe the location where the sample was collected.

25. SAMPLE FORM: Record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System.

26. COLOR: Record the color of the sample as determined from standard Munsell Color Charts.

27. ODOR: Record the odor of the sample or "none." See SOP No. 001 Section 5.

28. PID (HNu): Record the measured PID (HNu) values.

29. UNUSUAL FEATURES: Record anything unusual about the site or sample.

30. WEATHER/TEMPERATURE: Record the weather and temperature.

31. SAMPLER: Record your name.

3.1.2 Map File Form (Figure SOP016-3)

1. The map file logbook form will be located on the reverse of the field parameter logbook form, or on an adjoining page of the field logbook (if level book is used).

2. SITE ID: Record the Site ID from the field parameter form.

3. POINTER: Record the field sample number for the sample being pointed to.

4. DESCRIPTION/MEASUREMENTS: Describe the location where the sample was taken, along with distances to landmarks.

5. SKETCH/DIMENSIONS: Diagram the surroundings and record the distances to landmarks.

6. MAP REFERENCE: Record which U.S. Geological Survey Quad Map references the site.

7. COORDINATE DEFINITION: Write the compass directions the X- and Y-Coordinates of the map run.

8. COORDINATE SYSTEM: Write “UTM” (Universal Transverse Mercator).

9. SOURCE: Record the 1-digit code representing the Map Reference.

10. ACCURACY: Give units (e.g., write “1-M” for 1 meter).

11. X-COORDINATE: Record the X-Coordinate of the sample site location.

12. Y-COORDINATE: Record the Y-Coordinate of the sample site location.

13. UNITS: Record the unit’s map sections are measured in.

14. ELEVATION REFERENCE: Record whether topography was determined from a map or a topographical survey.

15. ELEVATION SOURCE: Record the 1-digit code representing the elevation reference.

16. ACCURACY: Record the accuracy of the map or survey providing the topographical information.

17. ELEVATION: Record the elevation of the sampling site.

18. UNITS: Write the units in which the elevation is recorded.

19. SAMPLER: Write your name.

3.2 SURFACE WATER LOGBOOK (Requires Figures SOP016-2 and SOP016-3)

3.2.1 Field Parameter Form (Items Unique to Figure SOP016-3)

1. CAL REF: Record the calibration reference for the pH meter.

2. pH: Record the pH of the sample.

3. TEMP: Record the temperature of the sample in degrees Celsius.

4. COND: Record the conductivity of the water.

5. For all other sections, see Section 3.2.1.

3.3 GROUNDWATER SAMPLING LOGBOOK (Requires Figures SOP016-2, SOP016-3, and SOP016-4)

3.3.1 Field Parameter Form (Items on Figure SOP016-4)

1. WELL NO. OR ID: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User's Guide for chemical data entry.

2. SAMPLE NO.: Record the reference number of the sample.

3. WELL/SITE DESCRIPTION: Describe the location where the sample was taken, along with distances to landmarks.

4. X-COORD and Y-COORD: Record the survey coordinates for the sampling site.

5. ELEV: Record the elevation where the sample was taken.

6. UNITS: Record the units the elevation was recorded in.

7. DATE: Record the date in the form MM/DD/YY.

8. TIME: Record the time, including a designation of AM or PM.

9. AIR TEMP.: Record the air temperature, including a designation of C or F (Celsius or Fahrenheit).

10. WELL DEPTH: Record the depth of the well in feet and inches.

11. CASING HT.: Record the height of the casing in feet and inches.

12. WATER DEPTH: Record the depth (underground) of the water in feet and inches.

13. WELL DIAMETER: Record the diameter of the well in inches.

14. WATER COLUMN HEIGHT: Record the height of the water column in feet and inches.

15. SANDPACK DIAM.: Record the diameter of the sandpack. Generally, this will be the same as the bore diameter.

16. EQUIVALENT VOLUME OF STANDING WATER: Use one of the following equations, to determine one equivalent volume (EV):

    1 EV = Volume in casing + volume in saturated sand pack. Or to restate:

    $$1\ EV = (BR_w^2h_w + 0.30B(R_s^2\text{-}R_w^2)h_s) * (0.0043)$$

    where

    R_s = Radius of sandpack in inches
    R_w = Radius of well casing in inches
    h_s = Height of sandpack in inches
    h_w = Water depth in inches

    0.0043 = gal/in.^{3}
    and filter pack porosity is assumed as 30 percent

    — OR —

    Volume in casing = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_c^2)(W_h)

    where

    R_c = Radius of casing in inches
    W_h = Water column height in feet

    Vol. in sandpack = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_b^2 - R_c^2)(W_h)(0.30)

    (if W_h is less than the length of the sandpack),

— PLUS —

Vol. in sandpack = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_b^2 - R_c^2)(S_h)(0.30)

(if W_h is greater than the length of the sandpack).

where
R_b = Radius of the borehole
S_h = Length of the sandpack.

Show this calculation in the comments section.

17. VOLUME OF BAILER OR PUMP RATE: Record bailer volume or pump rate.

18. TOTAL NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers required to remove 3 equivalent volumes (EV) of water from the well or the total purge time and volume as applicable.

19. WELL WENT DRY? Write "YES" OR "NO."

20. NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers or pump time which made the well go dry.

21. VOLUME REMOVED: Record the volume of water (gal) removed before the well went dry.

22. RECOVERY TIME: Record the time required for the well to refill.

23. PURGE AGAIN?: Answer "YES" or "NO."

24. TOTAL VOL. REMOVED: Record the total volume of water (in gal) removed from the well.

25. CAL REF.: Record the calibration reference for the pH meter.

26. TIME: Record time started (INITIAL T[0]), 2 times DURING the sampling and the time sampling ended (FINAL).

27. pH: Record the pH at start of sampling (INITIAL), twice DURING the sampling and at the end of sampling (FINAL).

28. TEMP: Record the water temperature (Celsius) at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

29. COND: Record the conductivity of the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

30. D.O.: Record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

31. TURBIDITY: Record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

32. ORD: Record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

33. HEAD SPACE: Record any positive readings from organic vapor meter reading taken in well headspace prior to sampling.

34. NAPL: Record the presence and thickness of any non-aqueous phase liquids (light or dense)

35. COMMENTS: Record any pertinent information not already covered in the form.

36. SIGNATURE: Sign the form.

3.4 FIELD CALIBRATION FORMS (Maintained as a separate logbook, or incorporated into sampling logbooks)

3.4.1 Items on Figure SOP016-5

1. Record time and date of calibration. Note whether 12- or 24-hour clock was used.

2. Record calibration standard reference number.

3. Record meter I.D. number

4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line.

5. Record value of reference standard (as required).

6. COMMENTS: Record any pertinent information not already covered on form.

7. SIGNATURE: Sign form.

3.5 GROUNDWATER HYDROLOGY TESTS LOGBOOK (Must include Figures SOP016-6 and SOP016-7 and/or SOP016-8, OR SOP016-9 or SOP016-10)

3.5.1 Field Permeability Test Data Sheet (Items on Figures SOP016-6)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

4. PROJECT NO.: Record the contractor assigned project number or the contract number.

5. LOCATION: Specific location

6. CLIENT: Agency or company with the contract under which the work is being performed.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

9. TEST TYPE: Short description of the type of test to be performed.

10. RISING/FALLING HEAD WITH SLUG: Check if the test involved the insertion/removal of and inert object.

11. RISING/FALLING HEAD WITHOUT SLUG: Check if the test involved the addition/removal of a quantity of water.

12. START DATE: Date on which the test was begun.

13. CLOCK TIME: Time each datum (depth to groundwater level) is collected. Note whether 12- or 24-hour clock was used.

14. ELAPSED TIME: Time since the last datum was collected.

15. DEPTH TO GWL (ft): Depth to the top of the groundwater table (Groundwater Level) as measured by manual methods.

16. REC. (ft): Water level as reported by transducer/datalogger (this is the depth of water above the transducer.

17. TIME: Time the discharge rate check was begun (addition or removal of water method). Note whether 12- or 24-hour clock was used.

18. FLOW METER (Addition or removal of water method): The amount of water added or removed as registered by the flowmeter, in gal of liters.

19. DISCHARGE RATE: Flowmeter reading divided by time interval (gal/min or liters/min).

20. SIGNATURE: The person completing this form must sign the form at the end of the test.

21. DATE: Date the form was signed.

3.5.2 Groundwater Levels – Single Well (Items on Figure SOP016-7)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: Remedial investigation wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATE: Date of each water level reading

16. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

17. ELAPSED TIME: Time since test was begun.

18. DEPTH TO WATER: Measured depth to the groundwater table.

19. WATER ELEVATION: Elevation of the top of the groundwater table (use datum listed above).

20. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

21. TAPE NO.: The unique identification number of the traceable standard tape used to calibrate the measuring device.

22. WELL STATUS: Condition of the well at the time of measuring (see abbreviation key at the bottom of the data sheet).

23. REMARKS: Any additional pertinent comments not specifically required above.

24. INITIALS: Initials of person completing this data entry.

25. ABBREVIATION KEYS: Self explanatory.

26. SIGNATURE: The person completing this form must sign the form at the end of the test.

27. DATE: Date the form was signed.

3.5.3 Groundwater Levels – Single Well (Items on Figure SOP016-8)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATALOGGER: This section is record of pertinent datalogger information.

16. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

17. MODEL: Enter the model number of the datalogger.

18. S/N: Enter the serial number of this datalogger.

19. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

20. TRANSDUCER: This section is a listing of pertinent information about the transducer used.

21. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

22. MODEL: Enter the model number of the transducer.

23. S/N: Enter the serial number of this transducer.

24. INPUT/UNITS: What are the units this transducer uses?

25. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

26. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer. (Usually in psi, or kpa).

27. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

28. VOLUME WATER ADDED/REMOVED: (Applicable if inert object insertion/removal method was not employed.) Record the volume of water added to or removed from the well.

29. DISCHARGE RATE: If z (above) is filled, enter the rate at which this water was added or removed.

30. INITIAL WATER LEVEL (ft): Enter the water level in the well at the beginning of the test.

31. PRESSURE TRANSDUCER SUBMERGENCE: Record the depth to which the transducer is submerged at the beginning of the test and the depth to the transducer at the end if the test. All depths will be recorded to the nearest 0.01 ft.

32. TIME: Record the time the test is begun and ended. Note whether 12- or 24-hour clock was used.

33. OBSERVED CHANGES IN ADJACENT WELLS: Note any changes in water levels in nearby wells.

34. RESULTS RECORDED ON DISKETTE #: Tracking number of the diskette on which these data are archived.

35. DISKETTE FILE NAME: Name of the file(s).

36. SIGNATURE: The person completing this form must sign the form at the end of the test

37. DATE: Date the form was signed.

3.6 GROUNDWATER LEVELS – MULTIPLE WELLS (Items on Figure SOP016-9)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

5. LOCATION: Specific location.

6. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

7. CLIENT: Agency with the contract under which the work is being performed.

8. REMARKS: Any pertinent observations not specifically required above.

9. WELL: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

10. DATE: Date this measurement was made.

11. TIME: Time this measurement was made. Note whether 12- or 24-hour clock was used.

12. DEPTH TO WATER: Depth from MP to top of groundwater table.

13. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

14. MP ELEV.: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

15. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

16. REMARKS/MP: Describe the location and nature of the measuring point.

17. INITIALS: Initials of the person completing this form.

18. ABBREVIATION KEYS: Self explanatory.

19. SIGNATURE: The person completing this form must sign the form at the end of the test.

20. DATE: Date the form was signed.

3.7 GROUNDWATER LEVELS – DATALOGGERS (Items on Figure SOP016-10)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019, Section 3.4).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

DATALOGGER (This section is a record of pertinent datalogger information)

15. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

16. MODEL: Enter the model number of the datalogger.

17. S/N: Enter the serial number of this datalogger.

18. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

TRANSDUCER (This section is a listing of pertinent information about the transducer used)

19. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

20. MODEL: Enter the model number of the transducer.

21. S/N: Enter the serial number of this transducer.

22. INPUT/UNITS: What are the units this transducer uses?

23. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

24. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer (usually in psi, or kpa).

25. "SUBMERGENCE = ___ (V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

26. DATE: Date of each water level reading

27. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

28. LOGGING TIME INTERVAL: Time since test was begun.

29. WL FEET BELOW MP: Measured depth to the groundwater table from measuring point.

30. SUBMERGENCE: Depth of water above the transducer.

31. MEAS.METHOD: What device/method was used to measure the water level.

32. TAPE NO.: Record the tape identification number.

33. TRANSDUCER MOVED?: Was the transducer moved since the last water level reading?

34. REMARKS: Any pertinent remarks not otherwise specified.

35. INITIALS:

DATA TRANSFER TO DISKETTE:

36. DATE: Date data were archived onto diskette.

37. TIME: Time stamp the computer assigns the data file.

38. FILE NAME: Name assigned the data file.

39. SOFTWARE USED FOR TRANSFER: Any special software, or computer operating system used to write the files to diskette. NOTE: If a "shareware" archiver which compresses files was used, and the archived file is not self-extracting, a copy of the unarchive program should be copied onto the diskette also.

40. OUTPUT FORMAT: What is the format of the output file? (DOS, UNIX, Binary, Compressed?)

41. INITIALS: Initials of the person who copied the data to diskette.

42. ABBREVIATION KEY: Self-explanatory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency. 1984. User's Guide to the Contract Laboratory Program. July.

FIGURE SOP016-1
FIELD PARAMETER LOGBOOK
SOIL AND SEDIMENT SAMPLES

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

INSTALLATION/SITE ________________________________ AREA ___________________

INST CODE FILE NAME ____

SITE TYPE SITE ID
FIELD SAMPLE NUMBER

DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.

DEPTH (TOP) DEPTH INTERVAL UNIT _____________

SAMPLING METHOD:

SPLIT SPOON AUGER SHELBY TUBE SCOOP OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS
SITE DESCRIPTION:____
SAMPLE FORM ______________________ COLOR _____________ ODOR _____________
PID (HNu) _______________________ UNUSUAL FEATURES _______________________
____
WEATHER/TEMPERATURE
SAMPLER

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

FIGURE SOP016-2
FIELD PARAMETER LOGBOOK
GROUNDWATER AND SURFACE WATER SAMPLES

INSTALLATION/SITE AREA
INST CODE FILE NAME SITE TYPE
SITE ID FIELD SAMPLE NUMBER
DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.
DEPTH (TOP) DEPTH INTERVAL UNITS

SAMPLING MEASUREMENTS

CAL REF.	pH	TEMPERATURE C	CONDUCTIVITY	OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS
SITE DESCRIPTION
SAMPLING METHOD
SAMPLE FORM COLOR ODOR
PID (HNu)
UNUSUAL FEATURES
WEATHER/TEMPERATURE ________________________ SAMPLER ________________

FIGURE SOP016-3
MAP FILE LOGBOOK

SITE ID POINTER ____________________
DESCRIPTION/MEASUREMENTS
SKETCH/DIMENSIONS:

MAP REFERENCE
COORDINATE DEFINITION (X is Y is)
COORDINATE SYSTEM SOURCE ACCURACY
X-COORDINATE Y-COORDINATE UNITS
ELEVATION REFERENCE
ELEVATION SOURCE ACCURACY ELEVATION
UNITS

SAMPLER

FIGURE SOP016-4
MAP FILE AND PURGING LOGBOOK
GROUNDWATER SAMPLES

WELL COORD. OR ID SAMPLE NO.______________
WELL/SITE
DESCRIPTION____
____
X-COORD. Y-COORD. ______________ ELEV. UNITS
DATE ____/____/____ TIME AIR TEMP.

WELL DEPTH _________ ft _________ in. CASING HT. _________ ft _______ in.
WATER DEPTH __________ ft _________ in. WELL DIAMETER __________ in.
WATER COLUMN HEIGHT _________ ft ________ in. SANDPACK DIAM. _______ in.
EQUIVALENT VOLUME OF STANDING WATER ____________ (gal) (L)
VOLUME OF BAILER ___________ (gal) (L) or PUMP RATE ___________ (gpm) (lpm)
TOTAL NO. OF BAILERS (5 EV)___________ or PUMP TIME ___________ MIN.
WELL WENT DRY? [Yes] [No] NUM. OF BAILERS _______ or PUMP TIME______MIN
VOL. REMOVED __________ (gal) (L) RECOVERY TIME __________ MIN
PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED __________ (gal) (L)

Date and Time	Quantity Removed	Time Required	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/ clarity/odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

COMMENTS:____
____
____
____

____
SIGNATURE

FIGURE SOP016-5
FIELD CALIBRATION: pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, OXIDATION-REDUCTION POTENTIAL, AND DISSOLVED OXYGEN METERS

INITIAL CALIBRATION	FINAL CALIBRATION
DATE:	DATE:
TIME:	TIME:

pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ______________________________

pH STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
7.0			
10.0			
4.0			

CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID _________________

COND. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

TEMPERATURE METER CALIBRATION

METER ID ________________

TEMP. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
ICE WATER			
BOILING WATER			
OTHER			

FIGURE SOP016-5 *(continued)*

TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: _______________

METER ID ____________________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

COMMENTS:____
____
____
____

____
SIGNATURE

FIGURE SOP016-6
FIELD PERMEABILITY TEST DATA SHEET

Contractor: **Seq. #** /

Project Name:	Project #:
Location:	Client:
Party Chief:	Contractor:
Observation Well:	
Test Type: Rising/Falling Head w/Slug	Rising/Falling Head w/out Slug

Start Date:								Discharge Rate		
Clock Time	Elapsed Time (min)	Depth to GWL (ft)	Rec (ft)	Clock Time	Elapsed Time	Depth to GWL (ft)	Rec (ft)	Time	Flow Meter	Discharge Rate

Signature: ____ Date: ______________________

FIGURE SOP016-7
GROUNDWATER LEVELS – SINGLE WELL

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:
Well No.: Site: Area:
Site: Area:
Area:

up (+)/down (-) from: Datum = MSL or:
Datum = MSL or:

Measuring Point Description:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:

Transducer: Manufacturer: Model: S/N:
Input/Units: Range:

Calibration:
Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v) / (mv)

Volume Water Added/Removed:
Discharge Rate:
Initial Water Level (ft):

Pressure Transducer Submergence
Initial (ft): Final(ft): Time:Start: End:
Observed Changes in Adjacent Wells:

Results Recorded on Diskette #:
Diskette File Name:

Signature: ____ Date: ______________________

FIGURE SOP016-8
GROUNDWATER LEVELS – MULTIPLE WELLS

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:

Measuring Point Description:
Remarks:
Well No.:
Site: Area: up (+)/down (-) from:
up (+)/down (-) from:
up (+)/down (-) from:
Datum = MSL or:

Date	Time	Elapsed Time	Depth to Water	Water Elevation	Meas. Meth.	Tape No.	Well Status	Remarks	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

Signature: ______________________________________ **Date:** _____________________

FIGURE SOP016-8 *(continued)*

Contractor: **Seq. #** /

Project No.:
Project Name: Location:
Field Party Chief: Client:

Well	Date	Time	Depth to Water	Stickup	MP Elev.	Meas. Meth.	Tape No.	Remarks/MP	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

FIGURE SOP016-9
GROUNDWATER LEVELS DATALOGGERS

Contractor

Project No.: **Well No.:**
Project Name: **Site:**
Field Party Chief: **Area:**

WELL DATA: Stickup: **(ft)** **up (+)/down (-) from:**
MP Elevation: **Datum = MSL or:**

Measuring Point Description:
Remarks:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:
Transducer: Manufacturer: Model: S/N:
Input/Units: Range:
Calibration: Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v)

Logging	Date	Time	Logging Time Interval	WL, ft Below MP	Submergence (logger reading)	Meas. Method	Tape No.	Well Status	Transducer Moved	Remarks	Initials
Start											
Stop											
Start											
Stop											

Data Transfer to Disk

Date	Time	File Name	Software Used for Transfer	Output Format	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently
NP = Nearby well pumping
NRP = Nearby well recently pumped
X = Obstructed

Signature **Date**

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Standard Operating Procedure No. 025
for
Soil Sampling

Prepared by

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Revision 0
December 2014

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for sampling surface and subsurface soils. Soil samples give an indication of the area and depth of site contamination, so a representative sample is very important.

2. MATERIALS

The following materials may be required:

Bucket auger or push tube sampler	Split-spoon, Shelby tube, or core barrel sampler
Drill rig and associated equipment	Stainless steel bowl
Personal protective equipment as required by the Health and Safety Plan	Stainless steel spoon, trowel, knife, spatula (as needed)

3. PROCEDURE

3.1 SUBSURFACE SAMPLES

Don personal protective equipment. Collect split-spoon, core barrel, or Shelby Tube samples during drilling. Upon opening sampler, or extruding sample, immediately screen soil for volatile organic compounds using either a photoionization detector or flame ionization detector. If sampling for volatile organic compounds, determining the area of highest concentration, use a stainless steel knife, trowel, or laboratory spatula to peel and sample this area. Log the sample in the Field Logbook while it is still in the sampler. Peel and transfer the remaining sample in a decontaminated stainless steel bowl. Mix thoroughly with a decontaminated stainless steel spoon or trowel. Place the sample into the required number of sample jars. Preserve samples as required. Discard any remaining sample into the drums being used for collection of cuttings. Decon sampling implements. All borings will be abandoned.

NOTE: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. The Field Logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Samples taken for geotechnical analysis will be undisturbed samples, collected using a thin-walled (Shelby tube) sampler.

3.2 SURFICIAL SOIL SAMPLES

Don personal protective equipment. Remove vegetative mat. Collect a sample from under the vegetative mat with a stainless steel trowel, push tube sampler, or bucket auger. If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite as follows:

- As each sample is collected, place a standard volume in a stainless steel bowl.
- After all samples from each hole or area are in the bucket, homogenize the sample thoroughly with a decontaminated stainless steel spoon or spatula.

If no compositing is to occur, place sample directly into the sample jars. Place the leftover soil in the auger borings and holes left by sampling. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas. Samples for volatile organic compounds will not be composited. A separate sample will be taken from a central location of the area being composited and transferred directly from the sampler to the sample container. Preserve samples as required. Decon sampling implements.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the Health and Safety Plan.

Soil samples will not include vegetative matter, rocks, or pebbles, unless the latter are part of the overall soil matrix.

6. REFERENCES

ASTM International. Method D1586-84, Penetration Test and Split-Barrel Sampling of Soils.

———. Method D1587-83, Thin Walled Sampling of Soils.

Department of the Army, Office of the Chief of Engineers. 1972. Engineer Manual 1110-2-1907 Soil Sampling. 31 March.

Standard Operating Procedure No. 059
for
Field Logbook

Prepared by

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording field survey and sampling information in the Field Logbook.

2. MATERIALS

The following materials may be required:

- Field Logbook (Teledyne 415 Level Book, or equivalent)[1]
- Indelible ink pen (e.g., Sharpie®).

3. PROCEDURE

All information pertinent to a field survey or sampling effort will be recorded in a bound logbook. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of line-out deletions that are initialed and dated. The person making the correction will provide a brief explanation for the change. Entries are factual only. No personal opinions should be entered.

There should be no blank lines on a page. A single blank line or a partial blank line (i.e., at the end of a paragraph) should be lined to the end of the page. If only part of a page is used, the remainder of the page should have an "X" drawn across it. The bottom of each page must be signed and dated by the field personnel entering the information.

At a minimum, entries in the Field Logbook will include but not be limited to the following:

- Date.

- Project number and project name.

- Name and address of field contact.

- Identification of sample crew members.

- Documentation should include model numbers of equipment used (e.g., drilling rigs) and calibration (if applicable). Each day's entry should begin with time onsite, who is onsite (including observers other than the sampling crew), brief description of what work will be performed that day and how, and the weather.

[1] Pre-printed, bound forms are approved as well. See SOP No. 016 for recommended content and format.

- If samples are being taken in or near tidal waters, the time of high and low tide for the site should be determined from local gauges or tables and recorded.

- References such as maps of the sampling site.

- Times of key daily milestones should be entered (e.g., time borings began, times personnel arrived and left site, times subcontractors arrived and left site, etc.). Time should be recorded in the left-hand margin on the page in military time.

- Sample-specific information:

  — Unique, sequential field sample number

  — Purpose of sampling

  — Location, description, and log of photographs of each sampling point

  — Details of the sample site (e.g., elevation of the casing, casing diameter and depth, integrity of the casing, etc.)

  — Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters and absorbing reagents)

  — Type of media of sample (e.g., groundwater, surface water, soil, sediment, and product)

  — Suspected waste composition

  — Number and volume of sample taken

  — Sampling methodology, including distinction between grab and composite sample

  — Sample preservation

  — Date and time of collection

  — Collector's sample identification number(s)

  — Sample shipment (e.g., name of the laboratory and cartage agent: Federal Express, United Parcel Service, etc.)

  — Field observations (e.g., oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, moisture content, layering, Unified Soil Classification System classification, etc.)

- Any field measurements made (e.g., pH, conductivity, explosivity, water depth, organic vapor analyzer readings, etc.)

- Signature and date by the personnel responsible for observations

- Decontamination procedures.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a Field Logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the sampler's memory. Further, the project work plan or field sampling plan should be reviewed to identify additional specific information or requirements that should be included in the Field Logbook.

The Project Manager will keep a master list of all Field Logbooks assigned to the Sampling Team Leaders. One Field Logbook kept by the Project Manager will be a master site log of daily activities and will contain the list of Field Logbooks assigned to Sampling Team Leaders.

Project name and number should be clearly marked on the outside cover using indelible ink. If more than one Field Logbook exists for the project, then the number of the Field Logbook should also be clearly marked on the outside cover.

4. MAINTENANCE

At the end of the field sampling effort, the Field Logbook should be scanned and filed in the electronic file for the project and maintained according to the EA Records Retention Policy or contract requirements.

5. PRECAUTIONS

None.

6. REFERENCES

EA Engineering, Science, and Technology, Inc., PBC. 2014. Standard Operating Procedure No. 016 for Surface Water, Groundwater, and Soil/Sediment Field Logbooks. December.

U.S. Environmental Protection Agency. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80.

———. 1990. *Sampler's Guide to the Contract Laboratory Program*. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. *User's Guide to the Contract Laboratory Program*. EPA/540/O-91/002, Directive 9240.0-01D. Office of Emergency and Remedial Response. January.

Appendix F3

EA MEC Field SOPS

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Munitions Response
Standard Operating Procedure No. 003
for
Vegetation Removal

Prepared by

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Revision 0
October 2018

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CONTENTS

1. SCOPE AND APPLICATION

1.1 PURPOSE

Vegetation removal/area preparation includes reduction and/or removal of vegetation that may impede or limit the effectiveness of removal actions, MEC tools and equipment, or geophysical data collection. Vegetation reduction/removal may be accomplished through manual removal, mechanical removal, or defoliation. Selection of the appropriate land clearing strategy will be based on the type, fuzing, and concentration of MEC; type and concentration of vegetation; topography; drainage patterns; terrain and soil conditions; and the level of required environmental and natural resource protection.

1.2 SCOPE

This Standard Operating Procedure (SOP) applies to all site personnel, including subcontractor personnel, involved in conducting vegetation removal at munitions response areas or sites. This SOP is not meant to be all inclusive, nor is it applicable in all situations. This SOP is not a standalone document; rather, it is to be used in conjunction with the applicable project-specific Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP); applicable federal, state, and local regulations; contract restrictions; and guidance.

2. MATERIALS AND EQUIPMENT

The following materials and/or equipment required for this activity include:

- Hand-held magnetometers and or all metal detectors (depending on the suspect munition item(s))
- Marking material listed in Table 2-1
- Stakes
- Appropriate safety equipment as dictated in the approved APP or SSHP.

Table 2-1. Flagging Color Codes – UXO Construction Support

Color	Description
Red Pin Flag[1]/Red Caution Tape	Danger, identified suspect MEC/UXO, special precaution required
Yellow Pin Flag[1]	Anomaly location
White Pin Flag[1]	Boundary or temporary marker
Green Paint	Marking MPPEH Collection Area
Pink/Orange Ribbon	Path or roadway

Note:
1. All pin flags will be plastic.

3. PROCEDURE

The Vegetation Removal Team will consist of three qualified personnel, as a minimum. These personnel may include any or all of the following:

- Unexploded ordnance (UXO) Technician III
- UXO Technician II or I
- Operator.

Personnel will not enter within 10 feet of an operating piece of equipment. If, at any time. personnel enter closer than 10 feet, the operator will immediately stop, return the engine to idle speed, and cease operations. Prior to operations commencing, a communications check with all team personnel will be conducted. Hand signals will be devised and used as a means of communication. All team personnel must know these hand signals prior to operations commencing. The hand signals will be documented on the tailgate safety-briefing sheet each morning of operations and at each change of team personnel.

The UXO Technician III will be responsible for the direction and manner in which the vegetation is to be removed. Prior to removal operations commencing, a visual search/survey is conducted to determine the hazards that may be encountered, which may include MEC, terrain slope, vegetation, wildlife, environmental concerns, and PPE requirements.

The UXO Technician III will perform a visual search for MEC, ordnance scrap, surface debris, and any other obstruction/object that may pose a hazard to team personnel. Hazardous items, impassable terrain, or vegetation that may affect operations will be marked and team personnel notified.

Team personnel are to ensure that a 6-inch ground clearance is maintained during removal operations. Those areas marked as hazards are to be avoided. The manner in which operations are accomplished will follow safe work practices and procedures. Areas of concern will be addressed to the SUXOS and/or UXOSO as needed. All MEC items encountered will be marked and avoided. Notification of these items will be made to the appropriate personnel.

If MEC is encountered during surface sweep activities, all MEC and material potentially presenting an explosive hazard will be managed of in accordance with the UFP-QAPP and applicable SOPs. All hazardous material encountered will be reported immediately to the SUXOS.

4. MAINTENANCE

All equipment (e.g., magnetometer, mowing equipment, etc.) will be used within the manufacturer’s specifications. Maintenance activities for the specific equipment used for the project will be performed in accordance with the manufacturer’s operations manual. General maintenance activities also include the daily visual inspection of instruments.

5. REFERENCES

U.S. Army Corps of Engineers (USACE). 2014. *Engineering Manual 385-1-1 Safety and Health Requirements Manual*. 30 November.

———. 2013. *Engineering Manual 385-1-97 Explosives Safety and Health Requirements Manual*. 17 May.

Munitions Response
Standard Operating Procedure No. 004
for
Surface Clearance Operations

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April 2017

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CONTENTS

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all EA Engineering, Science, and Technology, Inc., PBC (EA) employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of a munitions and explosives of concern (MEC) surface clearance using analog detector instruments. This SOP can also be used for reacquisition of geophysical anomalies.

2. SCOPE

This SOP applies to all EA site personnel, including subcontractor personnel, involved in the conduct of analog detection and surface removal actions on a site contaminated with MEC. The following EA policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the entire work plan, other EA SOPs, applicable federal, state, and local regulations, and contract restrictions and guidance.

3. MAINTENANCE

The Project Manager (PM), in collaboration with the Senior Unexploded Ordnance Supervisor (SUXOS) is responsible for the maintenance of this procedure. Approval authority rests with the Program Quality Control Manager.

4. PERSONNEL REQUIREMENTS / RESPONSIBILITIES

All Unexploded Ordnance (UXO) qualified personnel and UXO Technicians and support workers will meet the minimum qualifications for personnel conducting MEC related activities as per Department of Defense Explosive Safety Board (DDESB) Technical Paper 18 (TP-18).

4.1 PROJECT MANAGER

The PM shall be responsible for ensuring the availability of the resources needed to implement this SOP, and will also ensure that this SOP is incorporated into plans, procedures, and training for sites where this SOP is to be implemented. The PM is responsible for the development and implementation of any and all explosive planning documents such as the explosive safety submission (ESS) and explosive site plan (ESP) (as appropriate).

4.2 SENIOR UNEXPLODED ORDNANCE SUPERVISOR

The SUXOS is responsible for ensuring that this SOP is safely implemented. In addition, the SUXOS is responsible for oversight and supervision of field personnel, and ensuring compliance with this SOP and explosive planning documents such as the ESS and ESP (as appropriate). The SUXOS is also responsible for training all onsite personnel to include UXO qualified personnel, UXO Technicians, and support workers regarding their duties and responsibilities, the nature of the materials handled, the hazards involved, and the precautions necessary. The SUXOS will also ensure that the Daily Field Reports (as applicable) are completed

4.3 UNEXPLODED ORDNANCE SAFETY OFFICER

The UXO Safety Officer's (UXOSO) duties shall include, but are not limited to: analyzing MEC, explosives operational risk, hazards, and safety requirements; establishing and ensuring compliance with all site-specific safety requirements for MEC and explosives operations; enforcing personnel limits and safety exclusion zones for MEC surface clearance operations. The UXOSO is also responsible for ensuring compliance with all explosive planning documents such as the ESS and explosive site plan ESP (as appropriate).

4.4 UNEXPLODED ORDNANCE QUALITY CONTROL SPECIALIST

The UXO Quality Control Specialist (UXOQCS) duties shall include, but are not limited to: establishing and ensuring compliance with site-specific quality control requirements for MEC and explosives operations and all activities associated with MEC surface clearance in accordance with the approved work plan or quality assurance project plan (as applicable).

5. OPERATIONS

5.1 SURFACE CLEARANCE OPERATIONS

All analog detection and removal activities at MEC sites will be under the supervision of UXO qualified personnel. Non-essential personnel will not be allowed in the exclusion zone for MEC clearance operations unless prior approval is given by the contracting officer's representative. If access is required by non-UXO qualified and non-authorized personnel, all work will stop while they are in the exclusion zone.

Work may continue if authorized essential personnel are in the exclusion zone. This authorizing process will include approval by the EA PM, EA Corporate Safety and Health Director, the UXOSO, and the Ordnance and Explosives Safety Specialist (OESS) (if present). Project personnel listed in the Accident Prevention Plan (APP), including the UXO team, the global positioning team, excavation/sifting teams, and the field sampling teams, do not require this approval process. All authorized visitors will be given a safety briefing prior to entering the exclusion zone and will be provided a UXO-qualified escort regardless of their qualifications.

During operations, EA personnel will strictly adhere to the APP and the following general safety practices:

- Operations will be conducted during daylight hours only.

- Access to operating areas will be limited to only those personnel necessary to accomplish the specific operation.

- MEC determine unacceptable to move will not be handled, or disturbed.

- During MEC surface clearance activities the minimum separation distance (MSD) between UXO and non-UXO operations is the hazardous fragmentation distance (HFD) of the munition with the greatest fragmentation distance (MGFD), as stated in the approved explosives safety planning documents.

- During demolition operations personnel remaining onsite will be limited to those personnel needed to safely and efficiently prepare the item(s) for disposal.

- All personnel will attend the daily safety briefing (tailgate safety briefing) or a supplemental safety briefing provided by the UXOSO prior to entering the operating area.

- Anyone can stop operations for an unsafe act or situation.

- Safety violations and/or unsafe acts will be immediately reported to the UXOQCS / UXOSO.

- Failure to comply with safety rules/procedures may result in termination of employment.

5.2 GRID NETWORK ESTABLISHMENT

A **Real Time Kinematic** or similar will be used to survey each of the clearance areas. If this individual is not a UXO Technician, they will be accompanied by a UXO escort (see SOP No. MRS-008 MEC Anomaly Avoidance Operations for further guidance). Surveying activities will consist of locating clearance area boundaries, establishing permanent survey monuments, and establishing grids for geophysical investigation activities within the clearance areas.

If the UFP-QAPP requires lane clearance activities instead of grids, the same procedures will be followed for clearing the lanes as though they are grids. Stakes will be placed at the center of each 5-foot wide lane on the outer boundary of the MRS. If the underbrush or topography inhibits visibility for personnel to adequately maintain a straight line on the lane, then additional stakes will be placed throughout the lane to provide line of site for personnel to keep a straight line.

Depending on the method selected and approved by the client, the site layout and search grids or lanes will be established using a **Real Time Kinematic** or equivalent. Survey crews will be escorted in the field by a minimum of a UXO Technician II who will provide MEC avoidance, including checking the intended survey stake locations with an analog detector prior to driving stakes into the ground. This will prevent driving stakes into buried MEC.

5.3 ANALOG SURFACE CLEARANCE PROCEDURES

MEC surface clearances will include minimum of a UXO Technician III and a UXO Technician II. During MEC operations each UXO Technicians I will operate under the supervision of UXO Technicians II or III. UXO surface clearance operations will only be performed by UXO qualified personnel and UXO Technicians, which are defined as:

- MEC identification
- Access procedures such as excavation, either by hand or using heavy equipment
- Handling of MEC, explosives, or explosive items
- Disposal, including movement, transportation, and final disposal of MEC.

Analog hand held detectors are particularly effective in areas where vegetation and terrain limit the use of larger digital systems. Also, the use of analog hand held detectors should be used when there is insufficient difference between MEC at the site and other metallic fragments and debris, such that digital discrimination is ineffective or cost prohibitive.

5.3.1 Pre-Survey Field Operations

Handheld detectors and other electronic equipment will be maintained and tested or function tested in accordance with the manufacturer's instructions. Each piece of field equipment scheduled for that day's use will always be tested daily in a pre-established Instrument Verification Strip (IVS).

Tests and/or function checks will be observed by the UXOQCS and recorded in the UXOQCS daily log. If equipment field checks indicate that a piece of equipment is not operating correctly and field repair cannot be made, the equipment will be tagged and removed from service. Some handheld detectors are not and do not require calibration; they have a simple "Go/No Go" field operational check. Failure to detect the test targets is reason to reject the instrument and return it to the manufacturer for repairs. Documentation of the status of the handheld instruments will be recorded on the Team Leader's (Technician III's) daily journal/logbook.

5.3.2 Munitions and Explosives of Concern Surface Clearance Operations

Initially, individual search lanes will be established within each grid as applicable. Each lane will be searched using a handheld detector in order to aid in the detection of any surface items. The operation will begin at one end of each lane and move in a forward direction toward the opposing baseline. During the forward movement the technician moves the detector back and forth from one side of the lane to the other. Both forward movement and the swing of the detectors are performed at a pace that ensures the entire lane is searched and that the instrument is able to appropriately respond to metallic surface debris and subsurface anomalies. When a ring-off occurs the UXO Technician halts and investigates if the source of the ring-off on the surface. Throughout this operation the team leader closely monitors the team's individual performance to ensure these procedures are being performed correctly.

5.4 SURFACE MUNITIONS AND EXPLOSIVES OF CONCERN / UNEXPLODED ORDNANCE

MEC will be identified by two UXO Technician IIIs or greater. The SUXOS and UXOSO will determine whether or not the item is acceptable to move. If the item is determined to be acceptable to move the item can be consolidated with other MEC items for disposal. If determined to be unacceptable to move it will be marked (flagged) in accordance with the approved work plan or quality assurance project plan (as applicable) pending disposition. If disposal cannot be arranged the same day as the MEC is identified, a guard will be posted during the non-working hours to ensure the item is not disturbed or moved (see demolition SOP).

6. RECORD KEEPING

The team leader (UXO Technician III) will record at a minimum will contain a record of the following:

- Instrument details and serial number
- Team personnel
- Grids worked
- GPS location
- Start and stop times
- MEC items encountered
- Amount of Non-related munitions debris (NMRD)
- Disposition of all MEC.

The data to be recorded for each item discovered during anomaly excavation will include the following (as applicable):

- Type (e.g., munitions debris, material potential presenting an explosive hazard [MPPEH], UXO, and non-MEC scrap)
- Description (e.g., "projo, 20-millimeter, practice, MK105" and "base, coupling, firing device")
- Initial condition (e.g., expended, inert, live, and to be determined)
- Approximate length
- Approximate width
- Depth
- Approximate weight

- Found in a pit?
- Piece of fragmentation (i.e., munitions debris)?
- Initial disposition (e.g., left in place and removed to scrap pile)
- Requires disposal through demolition?

7. REFERENCES

EA Corporate Safety and Health Program.

OSHA, 29 CFR 1926, Construction Standards.

Applicable sections of U.S. Environmental Protection Agency (EPA), 40 CFR Parts 260 to 299, Protection of Environment.

Applicable sections of Department of Transportation, 49 CFR Parts 100 to 199, Transportation.

U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1, Safety and Health Requirements Manual.

USACE Engineering Regulations (ER) 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions.

USACE EM 385-1-97, Explosives Safety and Health Requirements Manual.

Department of Defense (DOD) 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives.

DOD Manual 6055.09-M, DOD Ammunition and Explosives Safety Standards.

DOD 4160.21-M, Defense Reutilization and Marketing Manual.

Department of the Army Pamphlet 385-64, Ammunition and Explosives Safety Standards.

Army Regulation (AR) 385-64, Ammunition and Explosives Safety Standards.

AR 200-1, Environmental Protection and Enhancement.

AR 385-10, The Army Safety Program.

AR 385-16, System Safety Engineering and Management.

AR 385-40 w/USACE supplement, Accident Reporting and Records.

Technical Manual (TM) 9-1300-200, Ammunition General.

TM 9-1300-214, Military Explosives.

Munitions Response Standard Operating Procedure No. 005 for Intrusive Operations

Prepared by

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April 2017

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CONTENTS

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all applicable EA Engineering, Science, and Technology, Inc., PBC (EA) employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of analog detection at sites potentially containing munitions and explosives of concern (MEC).

2. SCOPE

This SOP applies to all EA site personnel, including contractor and subcontractor personnel, involved in the conduct of analog detection and removal actions on a MEC-contaminated site. The following EA policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the entire work plan, quality assurance project plan (QAPP) (if applicable), other EA SOPs, applicable federal, state, and local regulations, and contractual requirements, restrictions and guidance documents. Consult the documents listed in Section 8.0 of this SOP for additional compliance issues.

3. MAINTENANCE

The Project Manager, in collaboration with the Senior Unexploded Ordnance Supervisor (SUXOS) is responsible for the maintenance of this procedure. Approval authority rests with the Program Quality Control Manager.

4. PERSONNEL REQUIREMENTS AND RESPONSIBILITIES

All unexploded ordnance (UXO) qualified personnel, UXO technicians, and UXO support workers will meet the minimum qualifications for personnel conducting MEC related activities as per Department of Defense Explosive Safety Board (DDESB) Technical Paper 18 (TP-18).

4.1 PROJECT MANAGER

The Project Manager is responsible for ensuring availability of resources to safely and effectively implement this SOP.

4.2 SENIOR UXO SUPERVISOR

The SUXOS will ensure that this SOP is implemented in plans, procedures, and training. In addition, he/she is responsible for oversight and supervision of field personnel, and ensuring compliance with this SOP and the work plan or QAPP (as applicable).

4.3 UXO QUALITY CONTROL SPECIALIST

The Unexploded Ordnance Quality Control Specialist (UXOQCS) ensures compliance with the project QAPP and uses analog hand held instruments and/or the instrument used for the detection of the anomaly (i.e., EM 61) to perform quality control surveillance of completed grids/transects and/or anomaly excavations in accordance with the work plan or QAPP (as applicable).

4.4 UXO SAFETY OFFICER

The Unexploded Ordnance Safety Officer (UXOSO) ensures that all activities, including intrusive investigation of anomalies and soil sampling, are conducted in a safe manner and in accordance with the approved work plan, QAPP, the accident prevention plan (APP), this SOP, and all applicable regulatory guidance. The UXOSO's duties shall include but are not limited to: evaluating operational risk, hazards, and safety requirements; establishing and ensuring compliance with all site-specific safety requirements and explosives operations; enforcing personnel limits and safety exclusion zones; and all activities associated with MEC and explosives transportation, storage, and destruction.

5. INTRUSIVE ACTIVITIES

Intrusive activities will be accomplished in accordance with the APP and applicable explosive safety documents, including the Explosive Safety Submission (ESS) or Explosive Site Plan (ESP). Safety Zones and team separation distances shall be established and maintained at all times as per the approved explosive safety documents. Authorized visitors, including non-essential personnel, shall request access via radio prior to entering an exclusion zone. Work will be suspended while non-essential personnel are within the exclusion zone.

5.1 GRID NETWORK ESTABLISHMENT

Depending on the approved method selected, site layout and grid network will be established using a Global Positioning System (GPS). Grid establishment may be accomplished by professional land surveyors (if required) or competent GPS operators and will be accompanied by a UXO Technician II or above who will provide UXO escort and anomaly avoidance during the boundary and grid network establishment. Grid corner stakes will be labeled in accordance with locations and procedures established in the work plan or QAPP (as applicable).

5.2 INTRUSIVE PROCEDURES

UXO team sizes vary and will be in accordance with the approved work plan or QAPP (if applicable). Intrusive operations require a minimum of one UXO Technician III (Team Leader) and one UXO Technician II.

5.2.1 Pre-Survey Field Operations

Handheld detectors and other electronic equipment will be maintained and tested or function tested in accordance with the manufacturer's instructions. Each piece of field equipment scheduled for that day's use will always be tested daily in a pre-established Instrument Verification Strip (IVS).

Tests and/or function checks will be observed by the UXOQCS and recorded in the UXOQCS daily log. If equipment field checks indicate that a piece of equipment is not operating correctly and field repair cannot be made, the equipment will be tagged and removed from service. Some handheld detectors are not and do not require calibration; they have a simple "Go/No Go" field operational check. Failure to detect the test targets is reason to reject the instrument and return it to the manufacturer for repairs. Documentation of the status of the handheld instruments will be recorded on the Team Leader's (UXO Technician III's) daily journal/logbook.

5.2.2 "Mag and Dig" Procedures

For "mag and dig" procedures, individual search lanes will be established within each specified grid. Each lane will be surveyed using a handheld detector. Mag and flag activities will begin at one end of each lane and move in a forward direction toward the opposing baseline. During the forward movement the technician moves the handheld detector back and forth from one side of the lane to the other. Both forward movement and the swing of the magnetometer are performed at a pace that ensures the entire lane is searched and that the instrument is able to appropriately respond to surface and subsurface anomalies. When a subsurface anomaly or surface object is encountered, the UXO Technician halts and investigates the anomaly or object at that time, or places a pin flag into the ground to mark its location for later investigation. Throughout this operation the team leader closely monitors the team's individual performance to ensure these procedures are being performed correctly.

5.2.3 Manual Anomaly Excavations

Excavations for individual anomalies will be conducted using the handheld detectors to assist the team in determining the location and orientation of the detected item. UXO Technicians excavating anomalies shall initially remove no more than a 6-inch layer of soil alongside the location of the anomaly, being careful not to impact the item. The UXO Technician will conduct a visual and instrument search using a detector to further pinpoint the anomaly as needed. This process shall be repeated until the audible signal from the magnetometer indicates the object is close to the surface. Once this determination has been made, soil will be removed by hand until the source of the anomaly is located.

5.2.4 Manual Anomaly Excavations Using Earth Moving Machinery

Earth Moving Machinery (EMM) may be used to excavate large anomalies (e.g., pits) or deep anomalies, if required. EMM will not be used to excavate within 12 inches of the suspected

MEC or material potential presenting an explosive hazard (MPPEH). The excavation will proceed slowly to ensure the item is not broached by the EMM. All anomalies shall be uncovered sufficiently by hand to obtain a positive identification of the item. While excavating with EMM, a UXO Technician will be stationed in a position that is out of the reach of the excavation equipment but affords a view of the excavation site.

In the event that EMM is used to excavate an anomaly within 12 inches of the suspected MEC or MPPEH, the equipment operator will be afforded a level of safety by incorporating engineering controls to protect the operator. This can be accomplished by "armoring" (shielding) the EMM as per DDESB TP-16.

6. RECORD KEEPING

The Team Leader (UXO Technician III) will maintain a field logbook that, at a minimum, will contain a record of the following:

- Weather
- Instrument details and serial number
- Team personnel
- Grids worked
- Start and stop times
- MEC items encountered.

The data to be recorded in the field logbook or on a field tablet for each item discovered during anomaly excavation will include the following (as applicable):

- Type (e.g., munitions debris, MPPEH, UXO, and non MEC related debris)

- Nomenclature (if possible) and description of the MEC item(s) (e.g., "projo, 20-millimeter, practice, MK105" and "base, coupling, firing device")

- Initial condition (e.g., expended, inert, live, and to be determined)

- Approximate length

- Approximate width

- Depth

- Orientation

- Approximate weight

- Found in a pit?
- Piece of fragmentation?
- Initial disposition (e.g., left in place and removed to scrap pile)
- Requires demolition or storage

7. REFERENCES

EA Corporate Safety and Health Program.

OSHA, 29 Code of Federal Regulations (CFR) 1910, Occupational Safety and Health Standards (OSHA).

OSHA, 29 CFR 1926, Construction Standards.

Applicable sections of U.S. Environmental Protection Agency (EPA), 40 CFR Parts 260 to 299, Protection of Environment.

Applicable sections of Department of Transportation, 49 CFR Parts 100 to 199, Transportation.

U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1, Safety and Health Requirements Manual.

USACE Engineering Regulations (ER) 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions.

USACE EM 385-1-97, Explosives Safety and Health Requirements Manual.

Department of Defense (DOD) 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives.

DOD Manual 6055.09-M, DOD Ammunition and Explosives Safety Standards.

DOD 4160.21-M, Defense Reutilization and Marketing Manual.

Department of the Army Pamphlet 385-64, Ammunition and Explosives Safety Standards.

Army Regulation (AR) 385-64, Ammunition and Explosives Safety Standards.

AR 200-1, Environmental Protection and Enhancement.

AR 385-10, The Army Safety Program.

AR 385-16, System Safety Engineering and Management.

AR 385-40 w/USACE supplement, Accident Reporting and Records.

Technical Manual (TM) 9-1300-200, Ammunition General.

TM 9-1300-214, Military Explosives.

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Munitions Response Standard Operating Procedure No. 006 for Munitions Debris Inspection

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CONTENTS

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the munitions potentially possessing explosive hazards procedures at EA Engineering, Science, and Technology, Inc., PBC (EA). This SOP is not meant to be all inclusive, nor is it applicable in all situations. This policy is not a standalone document; rather, it is to be used in conjunction with the applicable project-specific Quality Assurance Project Plan (QAPP); Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP); applicable federal, state, and local regulations; contract restrictions; and guidance.

2. SCOPE

This SOP applies to all site personnel, including subcontractor personnel, involved in the conduct of operations on munitions response sites requiring munitions debris (MD) / non-munitions related debris (NMRD) (e.g., scrap) inspection and certification activities. This SOP is not intended to contain all of the requirements needed to ensure compliance. Consult the documents listed in the reference sections of the work plan or QAPP, as applicable, and APP/SSHP.

3. MAINTENANCE

The Project Manager (PM), in collaboration with the Site Supervisor and or Senior Unexploded Ordnance Supervisor (SUXOS) is responsible for the maintenance of this procedure. Approval authority rests with the Program Quality Control Manager.

4. MATERIAL POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD INSPECTION AND CERTIFICATION

EA MEC projects will comply with the following procedures for collection, inspection, and certification and final disposal of Material Potentially Presenting an Explosive Hazard (MPPEH), MD, Range Related Debris (RRD), and NMRD.

MPPEH must be controlled and managed (e.g., sorted, segregated, stored, secured from the time of recovery through the release from Department of Defense (DoD) control to prevent its unauthorized use, transfer or release, and to protect personnel and property from uncontrolled exposures to potential explosive hazards. This must be accomplished by ensuring the chain-of-custody remains intact during the entire process from discovery to final disposition. See Attachment 1 Figure 1: MPPEH Process that depicts the MPPEH process from recovery to release from DoD control.

4.1 ROLES AND RESPONSIBILITIES

The following outlined section, addresses the roles and responsibilities for each position normally involved in military munitions response projects in regard to the planning, recovery, inspection process, handling, and storage of MPPEH, MD, RRD, and NMRD on military munitions response projects.

4.1.1 Project Manager

- Ensure that current and thorough MPPEH Management procedures are contained in the project plans.
- Ensure that the MPPEH management, inspection and certification procedures are being followed in accordance with the site-specific work plan and SOP.
- Coordinate final disposition of all Materials Documented as Safe (MDAS) with the EA approved recyclable facility.

4.1.2 Senior Unexploded Ordnance Supervisor

- Responsible for ensuring work and quality control (QC) plans specify the procedures and responsibilities for processing MPPEH for final disposition as MD, RRD, and NMRD.
- Ensure a requisition and turn-in document, DD Form 1348-1A is completed for all MD and RRD to be transferred for final disposition to an approved EA recycling facility.
- Perform a daily inspection (with the Unexploded Ordnance (UXO) QC Specialist [UXOQCS]) of all MPPEH collected (100%) and released by the UXO Technician III to ensure no items with explosive hazards, engine fluids, illuminating dials and other visible liquid hazards, toxic or radiological waste (HTRW) materials are identified as MD, RRD, or NMRD.
- Maintain one of two keys to the lockable container.
- Certify that all MD and RRD is free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials.
- Be responsible for ensuring that the daily inspected debris is secured in a closed, lockable container.
- Maintain the MDAS Container Log (Attachment 2, Form 005) for all lockable containers of certified MDAS.

4.1.3 Unexploded Ordnance Safety Officer

The Unexploded Ordnance Safety Officer (UXOSO) ensures all procedures for processing MPPEH are being performed safely and consistent with applicable regulations, the site-specific work plan, and associated guidance/planning documents.

4.1.4 Unexploded Ordnance Quality Control Specialist

- Conduct daily audits of the procedures used by UXO personnel to assess whether the processes and procedures as stated in the site-specific work plan and this SOP for MPPEH are being followed.

- Perform a daily inspection (with the SUXOS) of all MPPEH collected (100%) and released by the UXO Technician III to ensure no items with explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials are identified as munitions debris or range-related debris or NMRD.

- Ensure that the daily inspected MD and RRD is placed in a closed lockable container. All NMRD is to be placed in a second closed lockable container.

- Maintain one of two keys for each lockable container.

4.1.5 Unexploded Ordnance Technician III

- Performs a 100% daily re-inspection of all recovered items prior to departing the work area to determine if items are free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials and other visible liquid HTRW materials.

- Ensures that segregation is appropriate for all items not requiring demilitarization or venting from those items that do require demilitarization or venting.

- Segregates all MD, NMRD, and RRD prior to the SUXOS and UXOQCS inspection at the MPPEH collection point.

- If at any time an item is questionable, cannot be 100% identified, or its condition is undetermined, it will remain at the location discovered prior to being transported to the MPPEH collection point, pending evaluation and disposition by the SUXOS, UXOQCS, UXOSO, and Ordnance and Explosive Safety Specialist (OESS).

4.1.6 Unexploded Ordnance Technician II

- Weigh each item and perform a 100% inspection of each item as it is discovered and determine the following:

  — Whether the item is a UXO, MD, RRD, or NMRD.

- Whether the item contains explosives hazards or other dangerous fillers.
- If the item is suspected to be unacceptable to move and requires detonation.
- Whether the item requires demilitarization or venting to expose dangerous fillers.
- Whether the item requires draining of engine fluids, illuminating dials and other visible liquid HTRW materials.

- Segregate all items not requiring demilitarization or venting from those items that do require demilitarization or venting.
- The SUXOS and UXOSO will be notified immediately if items are found to contain other dangerous fillers. Items will not be moved pending assessment by the SUXOS and UXOSO.

4.1.7 Unexploded Ordnance Technician I:

A UXO Technician I can tentatively identify a located item as MPPEH, followed by a required confirmation by a UXO Technician II or UXO Technician III.

4.1.8 Unexploded Ordnance Sweep Personnel:

Unexploded Ordnance Sweep Personnel will only mark suspected items and will not be allowed to perform any assessment of suspect items to determine their status.

4.2 MUNITIONS DEBRIS CERTIFICATION AND VERIFICATION

The SUXOS will certify (prior to off-site release) that all MD and RRD is free of explosive hazards and the OESS will verify the MPPEH inspection process has been followed. If an OESS is not onsite, the UXOQCS, or a similarly trained individual can be delegated to verify the MPPEH process.

DD Form 1348-1A (Attachment 2, Form 001) will be used as certification/verification documentation. All DD 1348-A forms must clearly show the type or printed names of the SUXOS and the OESS (if present), organization, signature, and EA home office and field office phone number(s) of the personnel certifying and verifying the debris as free of explosive hazards.

4.2.1 Data Elements for DD Form 1348-1A

In addition to the data elements required and any locally agreed to directives, the DD 1348-1A form must clearly indicate the following for NMRD:

- Basic material content (Type of metal; e.g., steel or mixed)
- Estimated weight
- Unique identification of each of the containers and seals stated as being turned over
- Location where munitions debris or range-related debris was obtained
- Seal identification, if different from the unique identification of the sealed container.

4.2.2 Certification/Verification Statement (HTRW)

The following certification/verification will be entered on each DD 1348-1A for turnover of MD or RRD and will be signed by the SUXOS and the U.S. Army Corps of Engineers (USACE) OESS (if present). This statement will be used on any ranges where RRD is being processed along with MD.

"This certifies that the material listed has been 100 present properly inspected and, to the best of our knowledge and behalf is free of explosive hazards, engine fluids, illumination dials and other visible liquid HTRW materials."

4.2.3 Certification/Verification Statement (MD only)

The following certification/verification will be entered on each DD 1348-1A for turnover of MD and will be signed by the SUXOS on properties where only MD is being processed.

"This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials."

4.3 MAINTAINING THE CHAIN OF CUSTODY AND FINAL DISPOSITION

All certified and verified MDAS is no longer considered MPPEH as long as the chain-of-custody remains intact. The EA PM and SUXOS will arrange for maintaining the chain of custody of all MDAS while being transported offsite for final disposition. See Attachment 2, Form 002 for a copy of the MDAS chain-of-custody that is to be completed throughout the process. The certified and verified material will only be released to an organization approved by EA beforehand that agrees to the following procedure:

- Upon receiving the unopened labeled containers, each with its unique identified and unbroken seal ensuring a continued chain-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 will 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. See Attachment 2, Form 003 as an example.

- Send notification and supporting documentation to the EA PM documenting that the material in the sealed containers has been smelted and are now only identifiable by their basic content. See Attachment 2, Form 004 as an example.

This document will be incorporated by EA into the Final Report and maintained within the corporate office for a period of no less than 3 years as documentation supporting the final disposition of MDAS and RRD. 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 and incorporated by EA into any final action reports or the like.

4.3.1 Unsecured MDAS Container or Broken Seal on Container

If the MDAS container is discovered to be unsecured or if a Custody Seal has been applied and is discovered to be broken, the contents must undergo a second 100 % re-inspection. The re-inspection will be conducted and be documented to verify its explosives safety status (identified as either MD or RRD).

A legible copy of the re-inspection, and documentation must accompany the material through final disposition and be maintained for a period of 3 years thereafter.

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Attachment 1

MPPEH Process

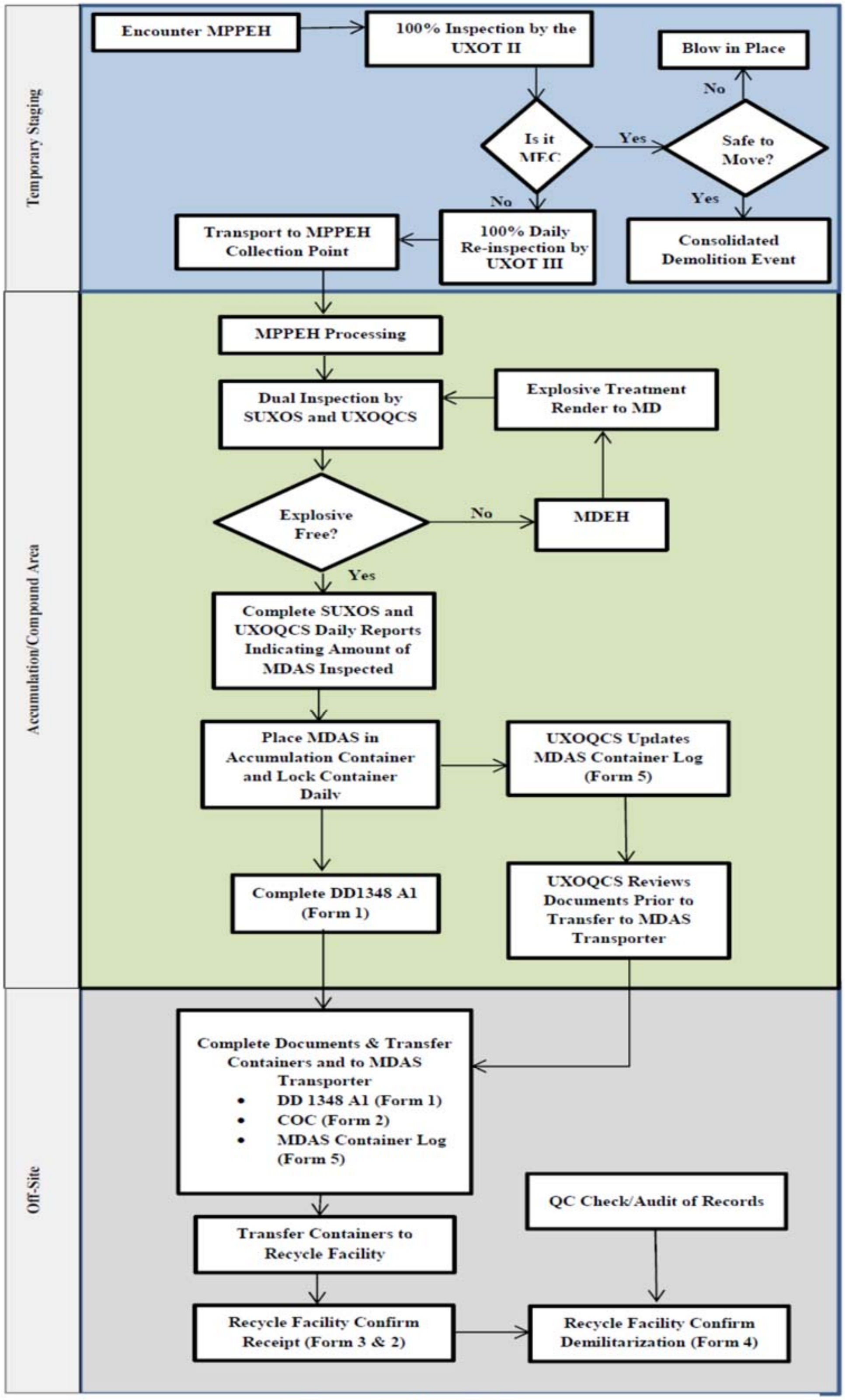

Figure 1: MPPEH Process

Attachment 2

Documentation Forms

Form 001 - DD 1348-1A

Form 002 - Material Documented as Safe (MDAS) Chain of Custody

Form 003 - Example Material Documented as Safe (MDAS) Receipt Form

Form 004 - Example Material Documented as Safe (MDAS) Disposal Confirmation Form

Form 005 - Material Documented as Safe (MDAS) Container Log

Form 001
DD 1348-1A

DOC IDENT | RI FROM | M & S | UNIT ISS | QUANTITY | SER | SUPPLEMENTARY ADDRESS | SIG | FUND | DISTRIBUTION | PROJECT | PRI | REQD DEL DATE | ADV | RI | O/P | COND | MGT

1. TOTAL PRICE — DOLLARS, CTS

UNIT PRICE — DOLLARS, CTS

2. SHIP FROM

3. SHIP TO

4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11. UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

25. NATIONAL STOCK NO. & ADD (8-22)

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

27. ADDITIONAL DATA

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

Form 002
Material Documented as Safe (MDAS) Chain-of-Custody Form

	Material Documented as Safe Certification Chain of Custody			
General	1. Generator's Name and Mailing Address			1.a Generator's Ph # ( )
	2. Project Location			2.a Project Ph # ( )
	3. MPPEH Contractor Name and Mailing Address			3.a MPPEH Contractor Ph# ( )
	4. Government Assigned Verification Name and Mailing Address (if used)			4.a Verifier Ph # ( )
	5. Transporter Name and Mailing Address			5.a Transporter Ph # ( )
	6. Recycler Name and Mailing Address			6.a Recycler Ph # ( )
	7. Container ID #	8. Security Seal #	9. Manifest #	10. Date
Explosives Safety Status / Certification and Verification	11. Description	12. Material	13. QTY	14. Unit (i.e., drum)
	15. MATERIAL DOCUMENTED AS SAFE CERTIFICATION: This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials.			
	16. SUXOS Certification			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	17. OESS Verification			
	Signature	Address	Date	
	Printed/Typed Name	Phone		
Transporter	**18. Transporter Acknowledgement of Receipt of Materials** (Receiving Signature Verifies that Container was Received with Seal Intact)			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	19. EA Acknowledgement of Transfer of Materials (Signature verifies that Container was Transferred to Transporter with Seal Intact)			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	20. Discrepancy Indication Space			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	21. Recycler Acknowledgement of Receipt of Materials (Receiving Signature Verifies that Drums were Received with Seal Intact)			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
Demil. and/or Recycle Facility	**22. DEMILITARIZATION/RECYCLING CONFIRMATION:** This certifies and verifies that each item or items contained have been demilitarized to the minimum requirements of DOD Instruction 4160.21-M-1, *Defense Demilitarization Manual*. (**To be signed by person performing the demilitarization – Recycler or UXO Technician**)			
	23. Recycler			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	24. Senior UXO Supervisor Verification			
	Signature	Address	Date	
	Printed/Typed Name		Phone	
	25. Final Disposition (If other than recycling)			

Form 003
Example Material Documented as Safe (MDAS) Receipt Form

Company XXXX Recycles Letterhead

Date: *DDMMYY*

Dear *Mr/Ms:*

On *DDMMYY*, the contents of sealed container/*s #EA 000X, Seal Serial Number XXXX* were received from EA Engineering, Science and Technology, Inc., *SOMEWHERE* project site.

Company XXXX Recycles has received and inspected the sealed container/s and agree that the material received is MD and contains no explosive hazards.

The contents of the sealed container/s are to be processed in accordance with DoD 4160-21 M-1, and will not be sold, traded or otherwise given to another party until the contents have been smelted and only identifiable by their basic content.

Enclosed is the signed Chain of Custody that was received along with the containers.

Signed:

Name:

Point-of-Contact Information:

Form 004
Example Material Documented as Safe (MDAS) Disposal Confirmation Form

Company XXXX Recycles Letterhead

Date: *DDMMYY*

Dear *Mr/Ms:*

I certify that the contents of sealed container/*s #EA 000X, Seal Serial Number XXXX* received on *DDMMYY* from EA Engineering, Science, and Technology, Inc. from *SOMEWHERE* project site were demilitarized in accordance with guidelines in DoD 4160.21-lVI-l and have been smelted and are only identifiable by their basic content.

Signed:

Name:

Point-of-Contact Information:

Form 005
Material Documented as Safe (MDAS) Container Log

Date	MDAS Type (Steel, Iron…)	Quantity	Certifier	Verifier	Container ID	Seal Number	COC Number	Total Items

Munitions Response Standard Operating Procedure No. 009 for Demolition/Disposal Operations

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 0
April 2017

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CONTENTS

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all EA Engineering, Science, and Technology, Inc., PBC (EA) employees and subcontractors the procedures to safely conduct explosive demolition/disposal of munitions and explosives of concern (MEC) activities.

2. SCOPE

This SOP applies to all site personnel, including contractor and subcontractor personnel, involved in the conduct of MEC demolition/disposal operations of MEC. This SOP is a living document and may not contain all of the requirements needed to ensure complete compliance, and should be used in conjunction with approved project plans and applicable referenced regulations.

3. MAINTENANCE

The Project Manager (PM), in collaboration with the Site Supervisor and or Senior Unexploded Ordnance (UXO) Supervisor (SUXOS) and UXO Safety Officer (UXOSO) is responsible for the maintenance of this procedure. Approval authority rests with the Program Quality Control (QC) Manager.

4. PERSONNEL REQUIRMENTS AND RESPONSIBILITIES

All UXO qualified personnel and UXO Technicians (UXOTs) and support workers will meet the minimum qualifications for personnel conducting MEC related activities per Department of Defense Explosive Safety Board (DDESB) Technical Paper 18 (TP-18).

4.1 PROJECT MANAGER

The PM shall be responsible for ensuring the availability of the resources needed to implement this SOP, and will also ensure that this SOP is incorporated into plans, procedures, and training for sites where this SOP is to be implemented. The PM is responsible for the development and implementation of any and all explosive planning documents such as the explosive safety submission (ESS) and explosive site plan (ESP) (as appropriate).

4.2 SENIOR UXO SUPERVISOR

The SUXOS will be responsible for ensuring that adequate safety measures and housekeeping are performed during all phases of site operations, to include demolition activities, and will visit site demolition locations, as deemed necessary, to ensure that demolition operations are carried out in a safe, clean, efficient, and economic manner. The demolition activities will be conducted under the direct control of the SUXOS, who will have the responsibility of supervising all demolition operations within the area.

The SUXOS is also responsible for training all onsite personnel to include UXO qualified personnel, UXOTs, and site workers regarding their duties and responsibilities, the nature of the materials handled, the hazards involved, and the precautions necessary. The SUXOS will also ensure that the Daily Field Reports (as applicable) are completed, Explosive Usage Report and magazine inventory are properly filled out and accurately depict the demolition events and demolition material consumption for each day's operations. The SUXOS will be present during all demolition operations or designate a competent person with the same training qualifications (pre-approved by the PM) to be in charge during any SUXOS absences.

4.3 UXO SAFETY OFFICER

The UXOSO for the site is responsible for ensuring that all demolition operations are being conducted in a safe and healthful manner, and is required to be present during all MEC demolition operations. The UXOSO will ensure the compliance of the demolition team with the above referenced documents that are applicable to the particular task being performed.

4.4 UXO QUALITY CONTROL SPECIALIST

The UXO QC Specialist (UXOQCS) is also responsible for ensuring the completeness of demolition operations records and for weekly inspection of the Explosives Record of Use, as well as completing the Daily QC Report, and QC Inspection Record. The UXOQCS, assisted by demolition team personnel, will inspect each demolition location and an area of appropriate radius after each demolition shot, in accordance with the approved Final Explosives Safety Submission, to ensure that there are no kick-outs, hazardous MEC components, or other hazardous items. In addition, post demolition locations will be checked with the appropriate hand held detector to check for any large metal fragments, hazardous debris, or evidence of a low order detonation. Any MEC discovered during the QC check will be properly disposed of using the demolition procedures dictated by this SOP and General Operational and Safety Procedures.

All personnel, (inclusive of subcontractor personnel, involved in operations) on MEC-contaminated sites will be familiar with the potential safety and health hazards associated with the conduct of demolition/disposal operations, and with the work practices and control techniques used to reduce or eliminate these hazards. All MEC and Material Potentially Presenting and Explosive Hazard (MPPEH) that cannot be disposed of that same day or stored in approved explosive storage magazines (as dictated in the explosive safety planning documents (i.e., ESS or ESP) will be guarded until disposal operations are concluded.

Extreme caution must be exercised when handling MEC that has been exposed to the forces of detonation. Personnel must adhere to acceptable safe practices and procedures when determining the condition of munitions and fuzes that have not been consumed in the disposal process.

During explosive demolition operations, the general safety provisions listed below will be followed by all personnel, at all times. Noncompliance with the general safety provisions listed below will result in disciplinary action, removal from the project site, and may lead to termination of employment.

All safety regulations applicable to demolition range activities and demolition and MEC materials involved will be complied with:

- Demolition of any kind is prohibited without an approved Final Explosives Safety Planning Documents (i.e., ESS or ESP).

- The quantity of MEC to be destroyed will be determined by the range limit, fragmentation and K (degree of protection provided)-Factor distance calculations.

- In the event of an electrical storm, dust storm, or other hazardous meteorological conditions, immediate action will be taken to cease all demolition operations and evacuate the area.

- In the event of a fire, which does not include explosives or energetic material, put out the fire using the firefighting equipment located at the site; if unable to do so, notify the fire department and evacuate the area. If injuries are involved, remove the victims from danger, administer first aid, and seek medical attention.

- The UXOSO is responsible for reporting all injuries and accidents that occur.

- Personnel will not tamper with any safety devices or protective equipment.

- Any defect or unusual condition noted that is not covered by this SOP will be reported immediately to the SUXOS, UXOQCS, and/or UXOSO for evaluation and / or correction.

- Methods of demolition will be conducted in accordance with this SOP and approved changes or revisions thereafter.

- Adequate fire protection and first aid equipment will be provided at all times.

- All personnel engaged in the destruction of MEC will wear clothing made of natural fiber, close-weave clothes, such as cotton. Synthetic material such as nylon is not authorized unless treated with anti-static material.

- Care will be taken to minimize exposure to the smallest number of personnel, for the shortest time, to the least amount of hazard, consistent with safe and efficient operations.

- Work locations will be maintained in a neat and orderly condition.

- All hand tools will be maintained in a good state of repair.

- Each heavy equipment and / or vehicle operator will have a valid operator’s permit or license for the equipment being operated.

- Equipment and other lifting devices designed and used for lifting will have the load rating and date of next inspection marked on them. The load rating will not be exceeded and the equipment will not be used without a current inspection date.

- Leather or leather-palmed gloves will be worn when handling wooden boxes, munitions, or MEC.

- Lifting and carrying require care. Improper methods cause unnecessary strains. Observe the following preliminaries before attempting to lift or carry:

  — When lifting, keep your arms and back as straight as possible, bend your knees and lift with your leg muscles.

  — Be sure you have good footing and hold, and lift with a smooth, even motion.

- Two forms of communication, capable of contacting appropriate personnel or agencies (i.e., medical response, etc.) must be present.

- Motor vehicles and material handling equipment (MHE) used for transporting MEC or demolition materials must meet the following requirements:

  — Exhaust systems will be kept in good mechanical repair at all times.

  — Lighting systems will be an integral part of the vehicle.

  — One Class 10B: C rated, portable fire extinguisher will, if possible, be mounted on the vehicle outside of the cab on the driver’s side, and one Class 10B: C fire extinguisher will be mounted inside the cab.

  — Wheels of carriers must be chocked and brakes set during loading and unloading.

  — No demolition material or MEC will be loaded into or unloaded from motor vehicles while their motors are running.

- Motor vehicles and MHE used to transport demolition material and MEC will be inspected prior to use to determine that:

  — Fire extinguishers are filled and in good working order.

  — Electrical wiring is in good condition and properly attached.

- Fuel tank and piping are secure and not leaking.
- Brakes, steering, and safety equipment are in good condition.
- The exhaust system is not exposed to accumulations of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials.

- Employees are required to wear leather or rubber gloves when handling demolition materials. The type of glove worn is dependent on the type of demolition material.
- A red warning flag, such as an "Active Range Flag" or a wind sock, will be displayed at the entrance to the demolition range during demolition operations when required by local authority. If applicable, the entrance gate will be locked when demolition work is in process.
- TP-16 and the Buried Explosive Module will be followed to determine fragmentation distances and to reduce Hazardous Fragmentation Distance (HFD) if needed.
- An observer will be stationed at a location where there is a good view of the air and surface approaches to the disposal site, before material is detonated. It will be the responsibility of the observer to order the SUXOS to suspend firing if any aircraft, vehicles, or personnel are sighted approaching the general demolition area.
- Two-way radios will not be operated in close proximity of demolition activities while the priming of the donor charge is. Radio transmissions and explosives will be separated by a minimum of 50 feet (ft).
- No demolition operation will be left unattended during the active portion of the operation (i.e., during the burn or once any explosives or UXO/MEC are brought to the range).
- A minimum radius (approximately 10 ft) around the demolition location will be cleared of dry grass, leaves, and other extraneous combustible materials around the demolition pit area.
- No demolition activities will be conducted if there is less than a 2,000-ft ceiling or if wind velocity is in excess of 20 miles per hour (mph).
- Demolition events must occur during daylight hours (minimum time for sunrise and sunset is determined by the firing procedure used (i.e., electric, non-electric).
- Notification of the local authorities will be made in accordance with the approved planning document and site requirements.

- Transporting demolition material with MEC is not permitted.

- No person will be allowed to ride in the trailer or bed of the truck.

- Vehicles will not be refueled when carrying demolition material or MEC, and must be 100 ft from magazines or trailers containing such items prior to refueling.

- All explosive vehicles will be cleaned of visible explosive and other contamination, before releasing the vehicles for other tasks.

- Prior to conducting any other task, personnel will wash their faces and hands after handling demolition material or MEC.

- Demolition pits will be spaced a safe distance apart, with no more than 10 pits prepared for a series of shots at any one time.

5. SPECIAL REQUIREMENTS FOR DEMOLITION ACTIVITIES

The following safety and operational requirements will be met during demolition activities. Any deviations from this procedure will be allowed only after receipt of written approval from the PM and the contracting officer representative (COR). 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.

5.1 GENERAL REQUIREMENTS

The general demolition range requirements listed below will be followed at all times:

- White Phosphorus and propellant will be disposed of only in an approved manner and following the guidance for maximum temperature exposure (90 degrees Fahrenheit).

- Material awaiting destruction will be stored at not less than intra-line distance, based on the largest quantity involved, from adjacent explosive materials and from explosives being destroyed. The material will be protected against accidental ignition or explosion from fragments, grass fires, burning embers, or detonating impulses originating in materials being destroyed.

- MEC or bulk explosives to be destroyed by open detonation. The components should be placed on their sides or in a position to expose the largest area to the influence of the demolition material. The demolition material should be placed in direct contact with the item to be detonated and held in place by tape or earth packed over the demolition materials.

- After each series of detonations, a search will be made of the surrounding area for MEC or indication of a low order. Items such as lumps of explosives or unfuzed ammunition may be picked up and prepared for the next demolition event. Fuzed ammunition, or items that may have internally damaged components, will be disposed of in place, if possible.

- Prevailing weather condition information can be obtained from the local weather service, or other acceptable source and the data logged in the Daily Field Report.

- All demolition charges will be dual primed.

- Upon completion of the project, all disturbed demolition areas will be thoroughly inspected for MEC. Depending upon contract requirements, the site may have to be backfilled and leveled. If necessary, this will be coordinated with the PM.

- Prior to and after each shot, the Daily Field Report, is to be filled out by the SUXOS with all applicable information.

5.2 ELECTRIC DETONATOR USE

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 pit is primed or during the priming process.

- The shunt will not be removed from the leg wires of the detonator until the continuity check of the detonator is to be performed.

- 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 itself; rather, hold the detonator leg wires approximately 1 inch (in.) 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 will 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 to not pull the detonators from the hole or sand bag. With the leg wires stretched to their fullest 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, re-shunt the wires by twisting the two ends together. Repeat this process for each detonator until all detonators have been tested. This process will be accomplished at least 50 ft from and downwind of any MEC or demolition materials and out of the demolition range personnel and vehicle traffic flow pattern. In addition, all personnel on the demolition range will 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 will remain short circuited until time to connect them to the firing line or Remote Firing Device (RFD) Receiver.

- At the power source end of the blasting circuit, the ends of the wires will 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 ends 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 or through the use of two-way radios, if the demolition pit is not visible from the firing point. If radios are used, communication will be accomplished a minimum of 50 ft from the demolition pit and detonators. The firing line will be checked for electrical continuity in both the open and closed positions, and will be closed/shunted after the check is completed.

- MEC to be detonated will be placed in the demolition pit and the demolition material placed / attached in such a manner as to ensure the total detonation of the MEC. Once the MEC and demolition material are in place and the shot has been tamped, the detonators will be connected to the detonation cord. Prior to handling any detonators that are connected to the firing line or RFD, personnel will ensure that they are grounded. The detonators will then be carried to the demolition pit with the end of the detonators pointed away from the individual. The detonators are then connected to the detonation 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 or RFD Transmitter, the entire firing circuit will be tested for electrical continuity and ohms resistance, or transmitting power (as applicable), to ensure the blasting machine or RFD Transmitter (distance) 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, will 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.

- Prior to initiating a demolition shot(s), a warning will be given; the type and duration of such warning will be determined by the prevailing conditions at the demolition range. At a minimum, this should be an audible signal using a siren, air horn, or megaphone, which is sounded for three blasts, five minutes prior to the shot, and again one minute prior to the shot.

5.3 NON-EL USE (SHOCK TUBE)

The following requirements are necessary when using NON-EL (Shock Tube) systems:

- 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 of 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.

- Always dispose of all short, cut-off pieces in accordance with local laws as they relate to flammable material.

The shock tube system is a thin plastic tube of extruded polymer with a layer of Pentaerythritol Tetranitrate (PETN) coated on its interior surface. The PETN propagates a shock wave, which is normally contained within the plastic tubing. The shock tube offers the controlled instantaneous action of electric initiation without the risk of premature initiation of the detonator by radio transmissions, high-tension power lines, or static electricity discharge. The NON-EL system uses detonators in the bunch blocks and in the detonator assembly, which are to be handled in accordance with approved procedures.

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 exposed ends of the shock tubes.

5.3.1 Shock Tube Demolition Procedures

> **WARNING**
> Although the detonation along the shock tube is normally contained within the plastic tubing, burns may occur if the shock tube is held.

5.3.2 Shock Tube Assembly

- Spool out the desired length of shock tube from firing point to demolition site and cut it off with a sharp knife or razor blade. Weight down the loose end of trunk line.

- Immediately seal off the shock tube remaining on the spool by tying a tight overhand knot in the cut-off end or use a push-over sealer.

- Using a sharp knife or razor, cut the sealed end off the detonator assembly.

- Push one of the shock tube ends to be spliced firmly into one of the pre-cut splicing tubes provided by the manufacturer at least ¼ in (Figure 1). Push the other shock tube end firmly into the other end of the splicing tube at least ¼ in. Secure splice with tape if needed.

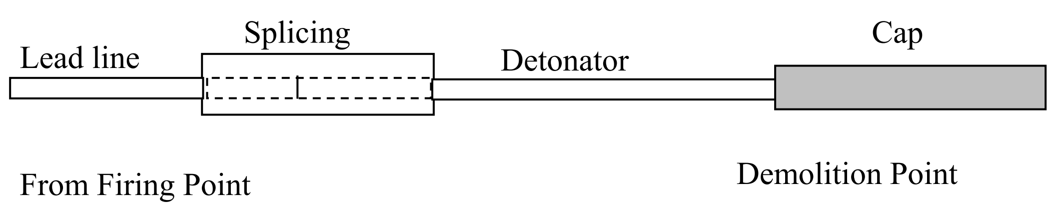


Figure 1

5.3.3 Firing Assembly Setup

1) 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.

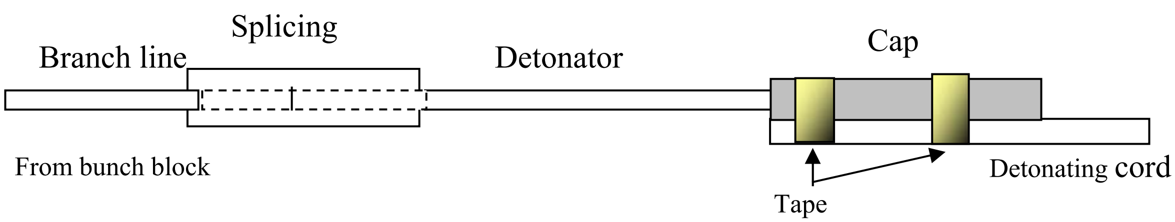
NOTE: No more than six leads may be used from any one bunch block.

2) If the detonator assembly has not been attached yet, then, using the splicing tube, splice the detonator assembly to the shock tube branch line as explained in the splicing instructions above.

3) 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 ft.

4) Tape the detonator assembly with cap to the detonating cord lead as shown in Figure .

Figure 2



5) Return to the firing position.

6) Cut off the sealed end of shock tube; proceed to the directions listed in Step 7. If you are using a previously cut piece of shock tube, using a sharp knife or razor blade, cut approximately 18 in. from the previously cut end, whether or not it was knotted in accordance with the above guidance.

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.

8) Take cover.

9) Signal **"Fire in the hole"** three times and initiate charge.

10) Observe a five-minute wait time after the detonation.

11) Remain in designated safe area until Demolition Supervisor announces **"All Clear."**

5.4 DETONATING CORD USE

The following procedures are required when using detonating cord (detonation cord):

- Detonation cord should be cut using approved crimpers, and only the amount required should be removed from inventory.

- When cutting detonation cord, the task should be performed outside the magazine.

- For ease of inventory control, remove detonation cord only in 1-ft increments.

- Detonation 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," original container, or a cloth satchel, depending upon the magazine location and proximity to the demolition area.

- Detonation cord should be placed at least 50 ft away from detonators and demolition materials until ready for use. To ensure consistent safe handling, each classification of demolition material will be separated by at least 25 ft until ready for use.

- When ready to "tie in" either the detonation cord to demolition materials, or detonation cord to detonator, the detonation cord will be connected to the demolition material and secured to the UXO / MEC. The cord is then strung out of the hole and secured in place with soil, or filled sandbags, being sure to leave a minimum of 6 ft of detonation cord exposed outside the hole.

- Once the hole is filled, make a loop in the detonation 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 detonation cord toward the demolition material or parallel to the main line.

- In all cases, ensure that there is a minimum of 6 ft of detonation cord extending out of the hole to allow for ease of detonator attachment and detonator inspection / replacement should a misfire occur.

- If the detonation cord detonators are electric, they will be checked, tied in to the firing line, and shunted prior to being taped to the loop. If the detonation cord detonators are non-electric, the time / safety fuze will be prepared with the igniter in place prior to taping the detonators to the detonation cord loop. If the detonation cord detonators are Non-El, simply tape the detonators into the loop as described above.

- In the event that a time / safety fuze is used, an igniter is not available, and a field expedient initiation system is used (i.e., matches), do not split the safety fuze until the detonator is taped into the detonation cord loop.

5.5 TIME / SAFETY FUZE USE

The following procedures are required when using a time / safety fuze:

- Prior to each daily use, the burn rate for the time / safety fuze must be tested to ensure the accurate determination of the length of time / safety fuze needed to achieve the minimum burn time of five minutes needed to conduct demolition operations.

- To ensure both ends of the time / safety fuze are moisture free, use approved crimpers to cut 6 in. off the end of the time / safety fuze roll, and place the 6–in. piece in the time / safety fuze container.

- If quantity allows, accurately measure and cut off a 6-ft-long piece of the time / safety fuze from the roll.

- Take the 6-ft section out of the magazine, and attach a fuze igniter.

- In a safe location, removed from demolition materials and MEC, ignite the time / safety fuze, measure the burn time from the point of initiation to the "spit" at the end, and record the burn time in the SUXOS' Log.

- To measure the burn time, use a watch with a second hand or chronograph.

- To calculate the burn rate in seconds per foot, divide the total burn time (in seconds) by the length (in., ft) of the test fuze.

- When using time / safety fuze for demolition operations, the minimum amount of fuze to be used for each shot will be the amount needed to permit a minimum burn time of five minutes.

5.6 DEMOLITION RANGE INSPECTION SCHEDULE

The schedule for the demolition range inspection will be followed when demolition operations are being conducted. This inspection will be conducted by the UXOQCS / UXOSO and will be documented in the Site Safety or QC Log. If any deficiencies are noted, demolition operations will be suspended and the deficiency reported to the SUXOS. Once the deficiencies are corrected, demolition operations may be resumed.

6. METEOROLOGICAL CONDITIONS

In order to control the effects of demolition operations and to ensure the safety of site personnel, the following meteorological limitations and requirements will apply to demolition operations:

- Demolition operations will not be conducted during electrical storms or thunderstorms.

- No demolition operations will be conducted if the surface wind speed is greater than 20 mph.

- Demolition operations will not be conducted during periods of visibility of less than 1 mile caused by, but not limited to, dense fog, blowing snow, rain, sand storms, or dust storms.

- Demolition will not be carried out on extremely cloudy days, defined as overcast (more than 80 percent cloud cover) with a ceiling of less than 2,000 ft.

- Demolition operations will not be initiated until an appropriate time after sunrise, and will be secured at an appropriate time prior to sunset.

7. PRE-DEMOLITION / DISPOSAL PROCEDURES

7.1 PRE-DEMO / DISPOSAL OPERATIONAL BRIEFING

It is the belief of EA that the success of any operation is dependent upon a thorough brief, covering all phases of the task, which is presented to all affected personnel. The SUXOS will brief all personnel involved in range operations in the following areas:

- Type of UXO / 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
- Route to the disposal site
- Equipment being used (i.e., galvanometer, blasting machine, firing wire, etc.)
- Misfire procedures
- Post-shot clean-up of range.

7.2 PRE-DEMO / DISPOSAL SAFETY BRIEFING

The EA SUXOS or UXOSO will conduct a safety brief for all personnel involved in range operations in the following areas:

- Care and handling of explosive materials

- Personal hygiene

- Two man rule, and approved exceptions

- Personnel roles and responsibilities

- Potential trip/fall hazards

- Horseplay on the range

- Stay alert for any explosive hazards on the range

- Calling a safety stop for hazardous conditions

- Location of emergency shelter (if available)
- Parking area for vehicles (vehicles must be positioned for immediate departure, with the keys in the ignition
- Location of range emergency vehicle
- Location of the assigned paramedic
- Wind direction (to assess potential toxic fumes)
- Locations of first aid kit and fire extinguisher
- Route to nearest hospital or emergency aid station
- Type of communications in event of an emergency
- Storage location of demolition materials and MEC awaiting disposal
- Demolition schedule.

7.3 TASK ASSIGNMENTS

Individuals with assigned tasks will report the completion of the task to the SUXOS. The types of tasks that may be required are:

- Contact local military authorities and fire response personnel, and get air clearance, as required
- Contact hospital/emergency response / medevac personnel, if applicable
- Secure all access roads to the range area
- Visually check range for any unauthorized personnel
- Check firing wire for continuity and shunt
- Prepare designated pits as required
- Check continuity of detonators
- Check time / safety fuze and its burn rate
- Designate a custodian of the blasting machine; fuze igniters, or NON-EL initiator

- Secure detonators in a safe location
- Place MEC in pit, and place charge in desired location.

7.4 PREPARING EXPLOSIVE CHARGE FOR INITIATION

To prepare the explosive charge for initiation, the procedures listed below will be followed:

- Ensure firing wire is shunted
- Connect detonator to the firing wire
- Isolate or insulate all connections
- Prime the demolition charge
- Place demolition charge on MEC
- Depart to firing point (if using non-electric firing system, obtain head count, pull igniters, and depart to designated safe area)
- Obtain a head count
- Give one minute warning signal, using a bullhorn or siren, five minutes prior to detonation, and again at one minute prior to detonation
- Check the firing circuit
- Signal "**fire in the hole**" three times (or an equivalent warning), and take cover
- If using electric firing system, connect firing wires to blasting machine, and initiate charge
- Remove firing wires from blasting machine and shunt or turn off RFD Transmitter
- Remain in designated safe area until SUXOS announces "**All Clear**." This will occur after a post-shot waiting period of five minutes and the SUXOS has inspected the pit(s).

8. 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 procedures listed below:

- After the "**All Clear**" signal, check pit for low orders or kick outs
- Examine pit, and remove any large fragmentation, as needed
- Back fill hole, as necessary
- Police all equipment
- Notify military authorities, fire department, etc., that the operation is complete.

9. 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 will be followed.

9.1 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 a charge.

- If unsuccessful, commence a 30-minute wait period.

- After the maximum delay predicted for any part of the shot has passed, the designated technician 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, 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.

9.2 NON-ELECTRIC MISFIRES

Working on a non-electric misfire is the most hazardous of all operations. Occasionally, despite all painstaking efforts, a misfire will occur. Investigation and corrective action should be undertaken only by the technician who placed the charge, using the following procedure:

- If charge fails to detonate at the determined time, initiate a 60-minute wait period plus the time of the safety fuze, i.e., five-minute safety fuze plus 60 minutes for a total of 65 minutes.

- After the wait period has expired, a designated technician will proceed down range to inspect the firing system. A safety observer must watch from a protected area.

- Prime the shot with a new non-electric firing system, and install a new fuze igniter.

- Follow normal procedures for initiation of the charge.

9.3 NON-EL MISFIRE

The use of a shock tube for blast initiation can present misfires, which require the following actions:

- If charge fails to detonate, it could be the result of the shock tube not firing. Visually inspect the shock tube; if it is not discolored (i.e., slightly black), it has not fired.

- If it has not fired, cut a 1-ft piece off the end of the tube, re-insert the tube into the firing device, and attempt to fire again.

- If the device still does not fire, wait 60 minutes and proceed down range to replace the shock tube per the instructions outlined below.

- If the tube is slightly black, then a "Black Tube" misfire has occurred, and the shock tube will have to be replaced, after observing a 60-minute wait time. When replacing the shock tube, be sure to remove the tube with the detonator in place. Without removing the detonator from the end of the tube, dispose of by demolition.

9.4 DETONATING CORD MISFIRE

EA uses detonation cord to tie in multiple demolition shots, and to ensure that electric detonators are not buried. Since detonation cord initiation will be either electrical or non-electrical, the procedures presented in Paragraphs 9.1, 9.2, or 9.3, as appropriate to the type of detonator used, will be used to clear a detonation cord misfire. In addition, the following will be conducted:

- 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 Paragraph 9.0.

- If the initiator detonated and the cord did not, inspect the cord to ensure that it is detonation cord and not time fuze. Also, check to ensure that there is PETN in the cord at the connection to the initiator.

- It may be necessary to uncover the detonation cord and replace it. This must be accomplished carefully, to ensure that the demolition charge and the MEC item are not disturbed.

10. RECORD KEEPING REQUIREMENT

To document the demolition operations procedures and the completeness of the demolition of MEC, the following record keeping requirements will be met:

- EA (as directed) will obtain and maintain all required permits.
- The SUXOS will ensure the accurate completion of the logs, and the SUXOS and UXOQCS will monitor the entries in the log for completeness, accuracy, and compliance with meteorological conditions.
- The SUXOS will enter the appropriate data on the Explosive Usage Report, to reflect the MEC destroyed, and will complete the appropriate information on the Explosives Accountability Log (Attachment 1) which indicates the demolition materials used to destroy the MEC.
- The quantities of MEC recovered must also be the quantities of MEC destroyed or disposed.
- EA will retain a permanent file of all demolition records, including permits; magazine data cards; training and inspection records; waste manifests, if applicable; and operating logs.
- Copies of the Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATF) License and any required State permits must be on hand.

11. SAFETY AND PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The following safety measures and personal protective equipment (PPE) will be used in preventing or reducing exposure to the hazards associated with MEC demolition / disposal operations. These requirements will be implemented unless superseded by site-specific requirements stated in the Accident Prevention Plan.

- Composite safety toe boots will be worn during MEC demolition/disposal operations.
- Safety glasses will be required whenever an eye hazard exists, for example, when during the handling of detonators or working around flying dirt / debris, using hand tools, etc. Safety glasses will provide protection from impact hazards.

- Positive means will be required to secure the PPE and prevent it from falling or dropping that may cause an accidental detonation.

12. REGULATORY REFERENCES

Applicable sections and paragraphs in the documents listed below will be used as references for the conduct of MEC demolition / disposal operations:

- EA Corporate Safety and Health Program
- OSHA General Industry Standards, 29 CFR 1910
- OSHA Construction Standards, 29 CFR 1926
- DDESB TP-16, Methodology for Calculation of Fragmentation Characteristics
- DoD 4160.21-M, Defense Reutilization and Marketing Manual
- DoD 6055.9-M, DoD Ammunition and Explosives Safety Standards
- AR 385-64, U.S. Army Explosives Safety Program
- AR 385-10, Army Safety Program
- DA PAM 385-64, U.S. Army Explosives Safety Program
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- Applicable TM 60 Series Publications
- AR 190-11, Physical Security of Arms, Ammunition, and Explosives
- AFM 91-201, Explosives Safety Standards
- ATF 5400.7, Alcohol, Tobacco, and Firearms Explosives Laws and Regulations
- DOT, 49 CFR, Parts 100 to 199, Transportation (applicable sections)
- EPA, 40 CFR Parts 260 to 299, Protection of Environment (applicable sections).
- AR 385-40 w/ Supplement 1, Accident Reporting & Records
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE EM 385-1-97, Explosives Safety and Health Requirements Manual

ATTACHMENT 1 – MEC ACCOUNTABILITY LOG

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MEC ACCOUNTABILITY LOG

Location: Task Order	Date Started:	Scrap Lbs:
UXO Team:		
Supervisor's Name:	Date Finished:	Page ____ of ____ Pages

ID #	GRID#	EASTING NORTHERN	NOMENCLATURE	FUZE DESCRIPTION	FUZE CONDITION	ALIGN-MENT	PLACE-MENT	DATE	COMMENTS

Standard Operating Procedure No. 14
for
Data Management and Quality Control of Field Documentation

Prepared by

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Revision 0
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CONTENTS

1. PURPOSE

The purpose of this standard operating procedure (SOP) is to provide EA Engineering, Science, and Technology, Inc., PBC (EA) employees and subcontractors with guidance for data management and quality control (QC) of intrusive investigation data recorded manually and/or electronically (i.e., paper forms or tablet).

2. SCOPE

This SOP provides procedures for the management and QC of all intrusive investigation data (including munitions and explosives of concern [MEC], munitions debris [MD], non-munitions related debris [NMRD], range related debris [RRD], and items of potential archaeological interest). The SOP includes requirements for data entry into the project database and internal QC functions to be performed, from the collection of the data to final submission of field documentation.

3. DOCUMENTATION

The following forms will be used to record and manage the intrusive data:

- **Dig Sheet:** This form is used in the field to record the findings made of the intrusive activities (i.e., depth of anomaly, type of item recovered, the person making contact, etc.). The Team Leader/Unexploded Ordnance (UXO) Technician III manually completes a Dig Sheet for each grid using the information gathered by their field team.

- **Grid Tracker:** This form provides a dynamic updated completion record of the effort completed at each grid identified for completion. It provides a summary of the dates digs, QC and quality assurance (QA) are completed, and documents the receipt of U.S. Army Corps of Engineers (USACE) concurrence with a USACE Form 948.

- **Team Leader Daily Log:** This form provides a daily summary of the intrusive activities completed by each field team on a given day on a per grid basis (i.e., number of anomalies marked in a grid, number of anomalies dug in a grid, pounds of MD identified, etc.). The Team Leader/UXO Technician III completes this form by summing the data gathered in all of the Dig Sheets completed that day.

- **OE Log:** This form is used to provide a summary of the MEC, MD, RRD, and NMRD that has been recorded onsite for a given day and to date. The OE Log summarizes pertinent data from the Team Leader Daily Log (i.e., percent complete, pounds of MD identified, etc.).

- **Senior UXO Supervisor (SUXOS) Daily Report:** This form is used to summarize the daily activities that occurred at the project site, including the personnel onsite, equipment used, work performed, QC inspections and tests, and safety inspections. The SUXOS Daily Report acts as a daily record for the SUXOS to document site activities.

A summary of the critical data elements for each of the above forms used during the investigation are shown on Table 3-1.

Table 3-1

Forms	Anomaly Details (location, etc.)	Anomaly Type and Description (MEC, MD, NMRD, Potential Archaeology Item of Interest, etc.)	Anomaly Description	Date Investigated	Dates of QC (Post Dig and Geo)	Type of MEC	Pounds of MD	Pounds of NMRD	Personnel Hours	Other Daily Activities
Dig Sheet	✓	✓	✓	✓	✓	✓	✓	✓	-	-
Team Leader Daily Log	-	-	-	✓	-	✓	✓	✓	-	-
OE Log	-	-	-	✓	-	✓	✓	✓	-	-
Grid Tracker Log	✓			✓	✓					
SUXOS Daily Report	-	-	-	-	-	-	-	-	✓	✓

4. MAINTENANCE

It is the responsibility of all personnel to perform data management and/or QC of field documentation. The Project Manager (PM), in collaboration with the Site Supervisor or the SUXOS is responsible for the implementation and monitoring of these procedures. Approval authority rests with the Program Quality Control Manager.

5. ROLES AND RESPONSIBILITIES

5.1 UNEXPLODED ORDNANCE TECHNICIAN II

During intrusive operations, the UXO Technician II will investigate anomalies with the assistance of a UXO Technician I or other qualified UXO Technician as part of a UXO dig team.

The UXO Technician II is responsible for reporting to the UXO Technician III the results of the investigation of the anomaly. As part of the dig team, the UXO Technician II provides the Team Leader/UXO Technician III with the dig results (i.e., depth of anomaly, type of item recovered, archeological item of interest or not) for input in the data management process.

5.2 TEAM LEADER/UNEXPLODED ORDNANCE TECHNICIAN III

- The Team Leader/UXO Technician III shall be responsible for gathering intrusive anomaly information (i.e. dig results) from the UXO Technician II.

- The Team Leader/UXO Technician III will conduct a 100% re-inspection of all recovered items that the UXO dig team investigated and document the intrusive activities on the Dig Sheets (Attachment A) to ensure proper classification (i.e., MEC, MD, NMRD, RRD, archeological item of interest, etc.).

- The Team Leader/UXO Technician III summarizes all of the Dig Sheets in which work was completed that day on the Team Leader Daily Log (Attachment B).

- Prior to providing the Dig Sheets and the Team Leader Daily Log to the UXO QC Specialist (UXOQCS) at the end of each work day, the Team Leader/UXO Technician III will check their own work for consistency and completeness.

5.3 UNEXPLODED ORDNANCE QUALITY CONTROL SPECIALIST

- On a daily basis, the UXOQCS will inspect the manual copy of the Dig Sheets and the Team Leader Daily Log for consistency and completeness and sign the signature block of the form as being verified and check for completeness.

- On a daily basis, the UXOQCS will provide the QC'd forms (Dig Sheets and the Team Leader Daily Log) to the Data Specialist for entry into the electronic (MSExcel) OE Log (Attachment C) and generation of the SUXOS Daily Report. The Data Specialist will also enter the field Dig Sheets into electronic format (MSExcel) on a daily basis.

- On a daily basis, after all data have been entered electronically by the Data Specialist and reviewed by the SUXOS, the UXOQCS will perform the following checks to ensure proper logging and documentation is complete:

  — Inspect the manually completed copy and electronic Dig Sheets
  — Inspect the Team Leader Daily Log and Dig Sheet entry into the OE Log
  — Review the SUXOS Daily Report.

5.4 DATA SPECIALIST

- On a daily basis, the Data Specialist enters the pertinent information from the manually completed copy of the Dig Sheets and Team Leader Daily Logs into the electronic OE Log, SUXOS Daily Report, Grid Tracker (Attachment D), and Dig Sheets.

- On a daily basis, after all data have been entered electronically, the Data Specialist provides the electronic Dig Sheets, Grid Tracker, OE Log, and SUXOS Daily Report to the SUXOS for inspection.

- On a weekly basis, after review by UXOQCS and SUXOS, the Data Specialist sends completed electronic Dig Sheets to the Anomaly Database Manager for entry into the anomaly database (MSAccess).

5.5 ANOMALY DATABASE MANAGER

On a weekly basis, the Anomaly Database Manager will load the Grid Sheets received from the Data Specialist into the anomaly database (MSAccess).

5.6 SENIOR UNEXPLODED ORDNANCE SUPERVISOR

- The SUXOS will oversee the proper implementation of this SOP during field activities.

- On a daily basis, the SUXOS Daily Report (generated by Data Specialist) and OE Log will be reviewed by the SUXOS. The SUXOS will include any additional relevant information to the SUXOS Daily Report.

- On a daily basis, the SUXOS will submit the SUXOS Daily Report and OE Log to the Ordnance and Explosive Safety Specialist (OESS) for signature. These forms will be subsequently forwarded on by the OESS to the EA PM and the USACE PM.

5.7 EA PROJECT MANAGER

- The EA PM has the overall responsibility for the implementation and execution of this SOP.

- The EA PM is responsible for ensuring the availability of the resources and materials needed to implement this SOP, ensuring that this SOP is incorporated into any future plans and procedures, and providing necessary and adequate training to all field personnel mentioned in this SOP prior to commencement of field operations, as well as any follow-up training deemed necessary.

- On a weekly basis, the EA PM will submit Dig Sheets that have passed QC to the USACE PM.

6. PROCEDURE

Personnel involved in the project shall be familiar with the field and electronic forms/databases and the information to be collected for each form, which is outlined below. This will help to ensure proper collection of data, including internal QC of the data.

6.1 DATA MANAGEMENT PROCURES

The data management and QC process for data collection, recording, and processing is detailed in Figure 6-1. Note: the process detailed on Figure 6-1 is for manual recording of field data; if electronic recording of field data is used a similar process will be followed. The data will be tracked through the QC process in accordance with the procedure outlined in this section of the

SOP using the RI database maintained by the Anomaly Database Manager. All data will be turned over to the Data Specialist at the end of each working day. It is critical that data not be lost or compromised through improper handling or inconsistent reporting. Data must be entered into electronic format and verified and reconciled (if needed) as soon as possible.

- All dig results collected by the dig team will be recorded on the manually completed Dig Sheets daily by the Team Leader/UXO Technician III. All of the critical data elements presented in Table 3-1 shall be included on the manually completed Dig Sheets.

- The Team Leader/UXO Technician III will summarize all Dig Sheets completed in that day on a Team Leader Daily Log (including all critical data elements presented in Table 3-1), and submit the Team Leader Daily Log and the Dig Sheets to the UXOQCS each day.

- The UXOQCS will review the logs, initial any changes, and return a copy of the revised logs to the Team Leader/UXO Technician III. The UXOQCS will require the Team Leader/UXO Technician III to address any changes, inconsistencies, and/or omissions.

- The UXOQCS will provide the Data Specialist with the corrected Dig Sheets and/or Team Leader Daily Log to enter the data into the electronic OE Log. The Data Specialist will perform the initial QC inspection by reviewing his or her own work (i.e., before moving to the next record, the person will confirm that the data are correct). All entered data will be printed and checked against the original data sheets.

- The SUXOS will compare the manually completed forms to the OE Log, electronic transferred Dig Sheets, and SUXOS Daily Report and check for completeness.

- The UXOQCS will inspect the manually completed copy and electronic Dig Sheets, SUXOS Daily Report, and OE Log.

- The SUXOS submits the SUXOS Daily Report, OE Log, and Dig Sheets to the OESS for review and signature.

- The EA PM will submit approved electronic Dig Sheets to the USACE PM.

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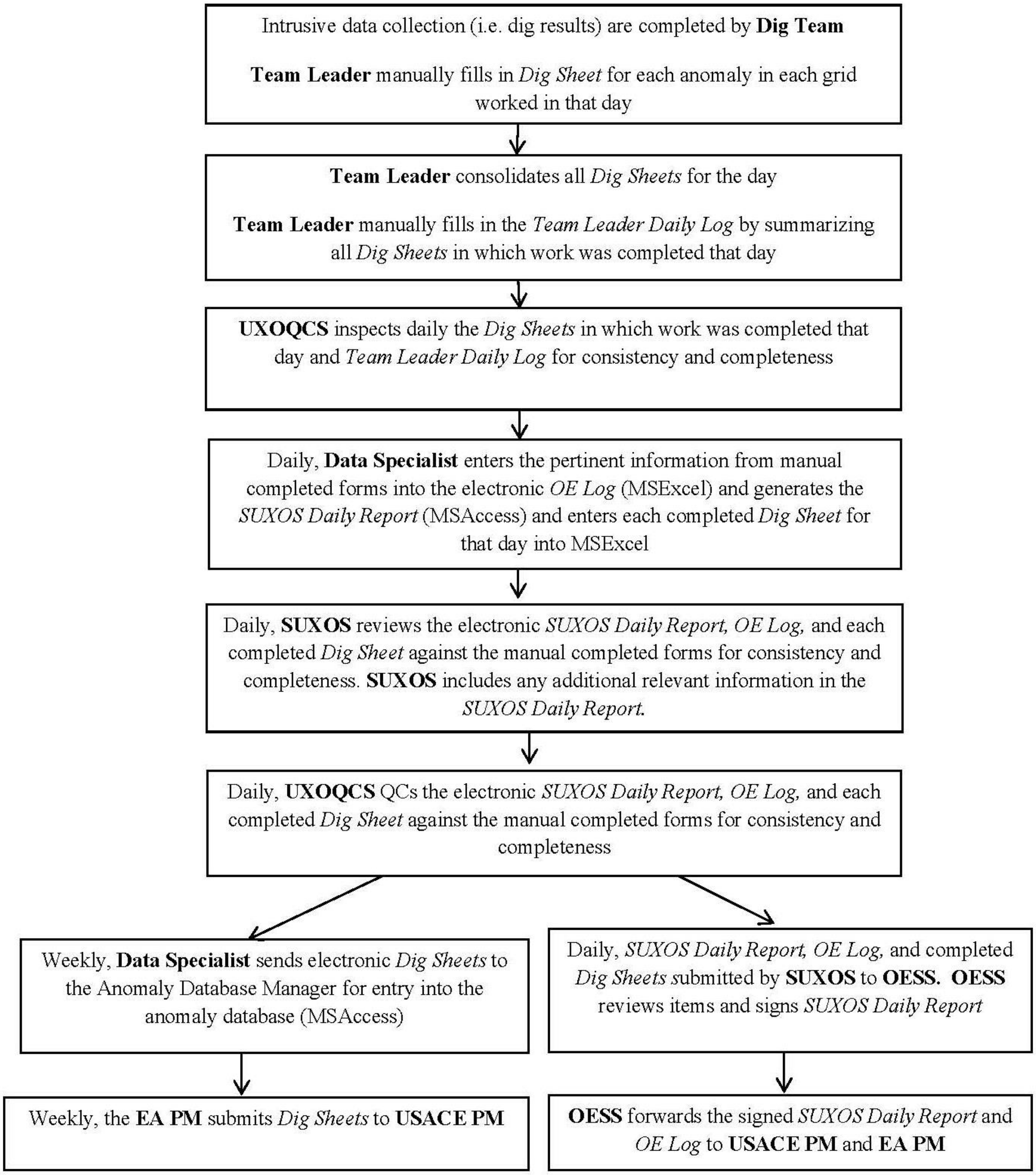
Figure 6-1 Data Management and QC



6.2 INVESTIGATION DATABASE

All field observations and measurements will be entered onto the manually completed Dig Sheet and Team Leader Daily Log and then entered into the electronic OE Log (MSExcel). The manually completed copy Dig Sheets will be entered into an electronic Dig Sheet database (MSExcel) and ultimately into the overall Project Anomaly Database (MSAccess).

6.3 DATAFILE BACKUP

When field personal computers (PCs) are used for preparing forms or storing data, the electronic data will be uploaded weekly from the field PC to the project server.

7. ATTACHMENTS

ATTACHMENT A	DIG SHEET (EXAMPLE)
ATTACHMENT B	TEAM LEADER DAILY LOG (EXAMPLE)
ATTACHMENT C	OE LOG (EXAMPLE)
ATTACHMENT D	GRID TRACKER SHEET (EXAMPLE)

Attachment A

Dig Sheet (Example)

Insert example Dig Sheets

Attachment B

Team Leader Daily Log (Example)

Insert team leader daily log

Attachment C

OE Log (Example)

Insert example of OE Log

Attachment D

Grid Tracking Log (Example)

Insert example of Grid Tracking Log

Grid:

Dig Sheet

Project Name:
Project Location:
Contractor:
Project Manager:

Coordinate System:
Survey Area ID:
Detection Equipment Used:

Name of Team Leader who dug the anomaly:
Name of UXOQCS that QC'ed 10% of digs:

Data entered by/Date:
QC data entry by/date:
CAR/948 Received:

	Dig Results										Post-Dig UXO QC Results (10%)						
Unique ID	Anomaly type - (MEC-UXO, MEC-DMM, MD, SAA, RRD, NC, NMRD, Seed, WT, ASP, A)	Anomaly Description	# of contacts in excavation	Approx. Length (in./ cm)	Depth to Center of Mass (in. /cm.)	Weight in pounds of all contacts	Digital Photo Filename (Grid #_1,2)	Post-Dig Signal Response	Post Dig Confirmation Check (Pass / Fail)	Date of Intrusive Investigation	Post-Dig Signal Response	UXO QCS Initials	Date QC'ed	Sample ID	Post BIP MC Sample ? (Y/N)	Comments on Sample (If Needed)	Samplers Initials
Total lbs NMRD:																	
Total lbs MD:																	
Total lbs MEC:																	

Note: 1. For ***Anomaly type*** , use MEC-UXO (Munitions & Explosives of Concern - Unexploded Ordnance), MEC-DMM (MEC-Discarded Military Munitions), MD (Munitions Debris), SAA (Small Arms Ammo), NC (No Contact), RRD (Range Related Debris), NMRD (Non-Munitions Related Debris), WT (Water Table - Excavation Not Complete), ASP (Asphalt- Excavation Not Complete), S (Seed), A (Potential Archaeological Item of Interest)

This is an example dig sheet that will be utilized going forward

Team Leader's Daily Log

Date: Team Leader Team

Grid	Square feet Completed	Percent Completed	Anomalies Marked	Number of Digs	Number of MEC/ MPPEH	lbs. of MD	lbs. of OD	Mag Used	Work Performed
Daily Totals									

UXO/MPPEH	Nomenclature	Grid	X	Y	Depth	GPS Coordinates	Disposition

Daily Summary

Team Leader's Signature

ORDNANCE AND EXPLOSIVE LOG

Volk Field, WI   Contract Number: W9128F-10-D-0056 DO: 0008

MRS:

Intrusive Operations on:

Data entered by:

Data checked by:

DATA SUMMARY:	RA FINDINGS				DEMILITARIZATION SUMMARY			
Nomenclature	MEC today (items)	MD today (lbs)	MEC to date (items)	MD to date (lbs)	MEC Vented/ Disposed/BIP today (items)	MEC Vented/ Disposed/BIP to date (items)	MD from Demil today (lbs)	MD from Demil to date (lbs)
Total	0	0.0	0	0.0	0	0	0	0

GRID INFORMATION:

Grids Worked In Today	Digs today	MD today (lbs)	NMRD today (lbs)	Percent Complete	MEC Today and Nomenclature
Total	0	0	0	0	0

TALLY:

	Today	To date
MD total weight (lbs)	0	0
NMRD total weight (lbs)	0	0
Grids completed	0	0
Grids QC	0	0
Grids QA	0	0
Total Demo Operations	0	0
Digs Complete	0	0

NOTES:

For grids that are not complete for a given day, only the digs and MEC items for this day are tracked and the pounds of MD and NMRD are tracked on the day that the grid is intrusively complete.

GRID TRACKER SHEET

EA Engineering, Science, and Technology, Inc., PBC

Project Name:

Data Interpretation				Intrusive Investigation									
Survey Area (Grid/Transect)	Date Interpreted	Interpreter	Interpretation Comments	Date Dig Package Sent to Dig Team	Re-aquire Date	Re-aquire Team	Date Intrusive Investigation Complete	Team	Date Data Quality Control (QC) Performed	QC Performed By	QC Reviewer Comments	Date Quality Assurance Performed	Date Dig Package Sent to Client

Standard Operating Procedure No. 16
for
Digital Geophysical Mapping Target Reacquisition

Prepared by

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CONTENTS

1. SCOPE AND APPLICATION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide general procedures for the reacquisition of targets identified during military munitions response (MMR) digital geophysical mapping (DGM) surveys. The objective of an MMR geophysical survey is to detect subsurface metallic objects that may be related to military munitions such munitions and explosives of concern (MEC). The reacquisition of targets identified during the DGM survey is required for the follow-on intrusive investigation to determine the nature of the targets.

1.2 LIMITATIONS

These procedures will be conducted in conjunction with project-specific Work Plans and Site Safety and Health Plans. This procedure shall not override any site-specific or contractual procedures that take precedent.

1.3 SCOPE

This SOP applies to the reacquisition of targets identified from the interpretation of geophysical sensor data. These guidelines will be used to locate targets identified as potential MEC and material potentially presenting an explosive hazard (MPPEH) through interpretation of the geophysical data. The major elements of this SOP are 1) system setup, 2) navigation/occupation of desired coordinates, 3) sensor interrogation, and 4) demarcation of coordinates.

Typically, a real-time kinematic (RTK) Global Positioning System (GPS) will be used with a geophysical instrument to locate and pin-point the positional x and y coordinates of a target previously identified during a DGM survey. Depending on site conditions and project objectives and requirements, other positional methods may be employed such as a robotic total station (RTS) or tape measures.

2. MATERIALS

2.1 EQUIPMENT

The following is a list of equipment that will be necessary to complete target reacquisition activities:

- Positioning system (e.g., RTK GPS, RTS, or tape measures)
- Geophysical detector (e.g., EM61-MK2, digital magnetometer, or hand-held detector)
- Logbook
- Color-coded sensor map and target list (e.g., dig package)
- Non-metallic pin flags or other means of demarcation
- Permanent marker (e.g., Sharpie)

- Spray Paint
- Clipboard.

3. METHODOLOGY AND PROCEDURES

The general procedures for target reacquisition consist of system setup, navigation to desired coordinates, sensor interrogation (if required), and demarcation of target location.

3.1 SYSTEM SETUP

- Set up positioning and detector equipment in accordance with equipment specific operating manual.

- Upload target coordinate information into positioning system.

- Reacquire a minimum of one “known” control point (e.g., grid corner, survey monument) prior to reacquisition of targets to ensure positioning system is functioning properly.

3.2 NAVIGATION/OCCUPATION OF COORDINATES

- Coordinates should be sorted as necessary to expedite reacquisition as much as possible.

- Use instrument stake-out mode to interactively navigate to coordinates of target.

- Monitor coordinates in real time to ensure target location is reacquired in accordance with the performance requirements of the project-specific Work Plan.

- Place positioning system over target location and observe coordinates and ensure they are within tolerance.

3.3 SENSOR INTERROGATION

- If required in the project-specific Work Plan or quality assurance project plan (QAPP) (as appropriate), check the area within the specified distance of the flag with the geophysical instrument for anomalies and locate the peak response location. The project-specific Work Plan or QAPP may require that all anomalies within a specified distance be flagged.

- If an item cannot be pinpointed due to ambiguity with the reacquire detector, the flag will be placed at the surveyed location. If an item cannot be detected with the reacquire detector, the flag will be placed at the surveyed location for investigation by the intrusive team. At the time of intrusive investigation, the team leader will also note any target offset from the marked location on the dig sheet.

- Record all required project specific data on the reacquisition form (e.g., paper or digital dig sheet). Required data may include distance from interpreted location (> 1 feet), direction, and peak instrument response. Also record additional comments, e.g. surface metal, next to fence, next to building, second anomaly, 2 feet north, etc.

3.4 DEMARCATION OF COORDINATES

- Mark the reacquired location with a nonmetallic pin flag or by other approved means.

- Ensure that the marker (i.e., pin flag) is pushed into the ground at least 3-4 inches. On hard surfaces, use another pre-approved method such as spray paint or metal pin flags.

- Ensure that the target ID number from the target list is written on the pin flag. Each marked target location within the each grid requires a unique number.

- Continue to the next target location until all targets on the dig sheet are flagged.

4. MAINTENANCE

All equipment (e.g., geophysical detector, data logger, GPS, RTS, etc.) will be used within the manufactures specifications. Maintenance activities for the specific equipment used for the project will be performed in accordance with the manufactures operations manual. General maintenance activities also include the visual inspection of any device cables and connections for cuts and/or exposed wiring, and for damage to the EM61-MK2 coils.

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Appendix G

Field Forms

Form G-1 – Field Personnel Qualifications and Verification Form
Form G-2 – Non-Conformance Report
Form G-3 – Corrective Action Request
Form G-4 – Corrective Action Plan
Form G-5 – Preparatory Phase Inspection Checklist
Form G-6 – Initial Phase Inspection Checklist
Form G-7 – Follow Up Inspection Checklist
Form G-8 – Final Inspection Checklist
Form G-9 – Inspection Schedule and Tracking Form
Form G-10 – Daily SUXOS Report
Form G-11 – QC Daily Report
Form G-12 – Safety Inspection Daily Report
Form G-13 – Field Change Request Form
Form G-14 – Vehicle Safety Inspection Checklist
Form G-15 – Daily Report
DGM Field Forms

EA Engineering, Science, and Technology, Inc., PBC

FIELD PERSONNEL QUALIFICATIONS AND VERIFICATION FORM (D-1)

*CANDIDATE:*_______________________________________ *POSITION/LEVEL:*_____________________________________

*PROJECT:*____

REVIEW ITEMS		*CANDIDATE QUALIFICATIONS*	*VERIFIED BY & DATE*
EXPERIENCE	*REQUIRED: AREA & YEARS*		
	ACTUAL: AREA AND YEARS		
EDUCATION	*REQUIRED: AREA & YEARS*		
	ACTUAL: AREA AND YEARS		
CERTIFICATION & REGISTRATIONS	*REQUIRED: AREA & YEARS*		
	ACTUAL: AREA AND YEARS		
TRAINING	*REQUIRED: AREA & YEARS*		
	ACTUAL: AREA AND YEARS		
OTHER	*REQUIRED: AREA & YEARS*		
	ACTUAL: AREA AND YEARS		

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EA Engineering, Science, and Technology, Inc., PBC

NON-CONFORMANCE REPORT (D-2)

PROJECT: **TO:** **ORIGINAL TO EA CORPORATE QC MANAGER**	**NCR NO.**	**DATE:**
ITEM: ____ **WORK PLAN REFERENCE** **REQUIREMENT:**____ **NONCONFORMANCE:**		
ISSUED BY: NAME:	**TITLE:**	**ORGANIZATION:**
DATE:		
DISPOSITION: ________**ACCEPT** ________**REJECT**		
DISPOSITION APPROVALS:		
UXOQCS DATE	FCR REQUIRED? ☐ YES ☐ NO	
PROJECT MANAGER DATE	DISTRIBUTION	
REMARKS:		

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CORRECTIVE ACTION REQUEST (CAR) (D-3)

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE

(1)PROJECT:		
(2) PROJECT MGR:	(3) QC MGR/STAFF:	
(4) CAR NO (S)AND DATE (S) ISSUED		
(5) DEFICIENCY DESCRIPTION AND LOCATION		
(6) PLANNED ACTIONS	(7) ASSIGNED RESPONSIBILITY	(8) COMPLETION DUE DATE
(9) PROJECT MANAGER SIGNATURE:	DATE:	

PART B TO BE COMPLETED BY QCS SYSTEM MANGER OR DESIGNEE

(10) CAP REVIEWED BY	DATE
(11) REVIEWER COMMENTS	
(12) CAP DISPOSITION: (CHECK ONLY ONE AND EXPLAIN STIPULATIONS, IF ANY. ☐ APPROVED WITHOUT STIPULATIONS ☐ APPROVED WITH STIPULATIONS ☐ APPROVED DELAYED, FURTHER PLANNING REQUIRED COMMENTS:	
(13) QC MANAGER SIGNATURE	DATE

EA Engineering, Science, and Technology, Inc., PBC

CORRECTIVE ACTION REQUEST (CAR) INSTRUCTION SHEET

(1) QC Manager: Verify that the total number of pages includes all attachments.

(2) QC Manager: Fill in CAR number from CAR log.

(3) CQC System Manager: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiencies impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) QC Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) QC Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) QC Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) QC Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) QC Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) QC Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) QC Manager: Indicate document closeout by signing and dating.

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CORRECTIVE ACTION PLAN (D-4)

(2) CAR#	(3) PRIORITY: HIGH ☐ NORMAL ☐	(4) DATE PREPARED:

PART A: NOTICE OF DEFICIENCY

(5) PROJECT:	
(6) PROJECT MGR:	(7) QC MGR/STAFF:
(8) CONSTRUCTION MGR:	(9) MRS MANAGER:
(10) ISSUED TO (INDIVIDUAL & ORGANIZATION)	
(11) REQUIREMENT & REFERENCE	
(12) PROBLEM DESCRIPTION & LOCATION: (13) CAP REQUIRED? YES ☐ NO ☐ (14) RESPONSE DUE:	
(15) ISSUED BY (PRINTED NAME & TITLE) SIGNATURE: DATE:	(16) MANAGEMENT CONCURRENCE:

PART B CORRECTIVE ACTION

(17) PROPOSED CORRECTIVE ACTION/ACTION TAKEN	
(18) PART B COMPLETED BY (NAME & TITLE) DATE	(19) QC CONCURRENCE

PART C

(20) CAR VERIFICATION AND CLOSE OUT: (CHECK ONLY ONE & AND EXPLAIN STIPULATIONS, IF ANY) ☐ APPROVED FOR CLOSURE WITHOUT STIPULATIONS ☐ APPROVED FOR CLOSURE WITH FOLLOWING STIPULATIONS COMMENTS/STIPULATIONS: (21) CLOSED BY (PRINTED NAME AND TITLE) SIGNATURE: DATE:

CORRECTIVE ACTION PLAN INSTRUCTION SHEET

(1) QC Manager: Verify that the total number of pages includes all attachments.

(2) QC Manager: Fill in CAR number from CAR log.

(3) CQC System Manager: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiencies impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) QC Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) QC Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) QC Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) QC Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) QC Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) QC Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) QC Manager: Indicate document closeout by signing and dating.

EA Engineering, Science, and Technology, Inc., PBC

PREPARATORY PHASE INSPECTION CHECKLIST (PART I) (D-5)

PROJECT: ____ DATE:_________________

TITLE AND NO. OF THE TECHNICAL SECTION:

____
____
____

WORK PLAN REFERENCE:____

A. ATTENDANTS:

NAME	POSITION	COMPANY
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

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B. SUBMITTALS REQUIRED TO BEGIN WORK:

ITEM	SUBMITTAL NO.	ACTION CODE
1.		
2.		
3.		
4.		
5.		
6.		

C. EQUIPMENT TO BE USED IN EXECUTING WORK:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________

D. WORK AREAS EXAMINED TO ASCERTAIN THAT ALL PRELIMINARY WORK HAS BEEN COMPLETED:

____
____
____

E. METHODS AND PROCEDURES FOR PERFORMING QUALITY CONTROL, INCLUDING SPECIFIC TESTING REQUIREMENTS:

____
____
____

EA Engineering, Science, and Technology, Inc., PBC

PART II

A. PERSONS IN ATTENDANCE: SEE MEETING ATTENDANCE SHEET (ATTACHED)

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. ____

I HEREBY CERTIFY, THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THAT THE ABOVE REQUIRED MATERIALS DELIVERED TO THE JOB SITE ARE THE SAME AS THOSE SUBMITTED AND APPROVED.

NAME OF PROJECT QC SPECIALIST: ____

DATE:___________________________

SIGNATURE OF PROJECT QC SPECIALIST:____

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INITIAL PHASE INSPECTION CHECKLIST (PART I) (D-6)

PROJECT: ____ DATE:________________

TITLE AND NO. OF THE TECHNICAL SECTION:

____

____

____

DESCRIPTION AND LOCATION OF WORK INSPECTION

____

____

A. KEY PERSONNEL PRESENT:

NAME	POSITION	COMPANY
1.		
2.		
3.		
4.		
5.		
6.		

B. MATERIALS BEING USED ARE IN STRICT COMPLIANCE WITH THE CONTRACT SPECIFICATIONS: YES ☐ NO ☐

IF NOT EXPLAIN BELOW:

____

____

____

____

EA Engineering, Science, and Technology, Inc., PBC

C. PROCEDURES AND/OR WORK WITNESSED ARE IN STRICT COMPLIANCE WITH THE CONTRACT SPECIFICATIONS: YES ☐ NO ☐

IF NOT EXPLAIN BELOW:

____

____

____

____

D. WORKMANSHIP IS ACCEPTABLE : YES ☐ NO ☐

STATE WHERE IMPROVEMENT IS NEEDED:

____

____

____

____

E. WORKMANSHIP IS FREE OF SAFETY VIOLATIONS : YES ☐ NO ☐

IF NO, CORRECTIVE ACTION TAKEN:

____

____

____

____

NAME OF PROJECT QC SPECIALIST: ____

DATE:______________________

SIGNATURE OF PROJECT QC SPECIALIST:____

EA Engineering, Science, and Technology, Inc., PBC

FOLLOW-UP PHASE INSPECTION CHECKLIST (D-7)

DATE:______________________________________

COMPANY/CONTRACTOR:____

PROJECT:____

Y=YES; N=NO; SEE REMARKS BLANK=NOT APPLICABLE	
WORK COMPLIES WITH WORK PLAN AS APPROVED IN INITIAL PHASE	

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION, AND LIST PERSONNEL PRESENT

INSPECTION PERFORMED & WHO PERFORMED TEST

NAME OF PROJECT QC SPECIALIST: ____

DATE:__________________________

SIGNATURE OF PROJECT QC SPECIALIST:____

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FINAL INSPECTION CHECKLIST (D-8)

(PART I)

PROJECT____ DATE:___________________

AREA OF INSPECTION :

____

____

____

____

A. DEFINABLE FEATURE OF WORK: STATUS OF

INSPECTION:____

____

____

____

____

____

____

____

I HEREBY CERTIFY, THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF, THAT THE WORK INSPECTED IS COMPLETE AND ALL MATERIALS AND EQUIPMENT USED AND WORK PERFORMED WERE COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS.

NAME OF PROJECT QC SPECIALIST: ____

DATE:________________________

SIGNATURE OF PROJECT QC SPECIALIST:____

EA Engineering, Science, and Technology, Inc., PBC

FINAL INSPECTION CHECKLIST (D-8)
MEETING ATTENDANCE LIST
(PART II)

MEETING:		DATE:
NAME	**ORGNAIZATION**	**PHONE NUMBER**

EA Engineering, Science,
and Technology, Inc., PBC

INSPECTION SCHEDULE AND TRACKING FORM (D-9)

PROJECT:	PROJECT MANAGER:	PROJECT QC MGR/STAFF:

REFERENCE NUMBER	DEFINABLE FEATURE OF WORK	PREPARATORY		INITIAL		FOLLOW-UP		COMPLETION		
		DATE PLANNED	ACTUAL DATE	DATE PLANNED	ACTUAL DATE	PLANNED BEGIN/END	ACTUAL DATE	PLANNED BEGIN/END	ACTUAL DATE	STATUS

REMARKS:

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Report Date:
Project No:
Report No:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

DAILY SUXOS REPORT (D-10)

REMEDIAL INVESTIGATION

Assateague Island FUDS, Maryland

WORKDAY WEATHER:

Weather Description	High (°F)	Low (°F)	Humidity (%)	Rainfall (%)

GOVERNMENT PERSONNEL (name/org):

SITE VISITORS (name/org):

WORK PERFORMED BY CONTRACTORS/SUBCONTRACTORS:

Name	Team #	Title	Hours	Description of Work	Company

OPERATING EQUIPMENT DATA (Not hand tools):

Equipment	User	Equipment ID/TAG	Hours Used	Check

SUMMARY OF WORK PERFORMED:

Grid/Transect Status

Completed	
Partially Completed	

Report Date:
Project No:
Report No:

Grid/Transect Results

Team #	Clearance Phase	Grid/ Transect	# of Anomalies	MEC Total Weight (lbs)	MD Total Weight (lbs)	NMRD Total Weight (lbs)	RRD Total Weight (lbs)	Other Total Weight (lbs)

*See MEC Summary table below for individual MEC results.

MEC Summary

MRS	Grid/ Transect	MEC ID	MEC Type	MEC Identification Description	MEC Depth (in)	MEC Approx. Weight (lbs)	Acceptable to Move?	GPS Location Collected?

Demo Summary

Demo Number	Time of Demo	MEC ID of Items	Demo Location (ie. Grid ID and MRS or brief description of demo site if located elsewhere)	GPS Location Collected?

ADDITIONAL REMARKS:

Report Date:
Project No:
Report No:

QUALITY CONTROL INSPECTIONS AND RESULTS

QA/QC Grid/Transect Status

Clearance Phase	Grid/ Transect	QA/QC Status

Seed Results

Clearance Phase	Grid/ Transect	QA Seed Serial #	QC Seed Serial #

QC Inspections:

Summary of Deficiencies:

Corrective Actions:

Additional Notes:

SAFETY INSPECTIONS AND RESULTS

Inspections:

Report Date:
Project No:
Report No:

Summary of Deficiencies:

Corrective Actions:

Additional Notes:

CONTRACTOR'S VERIFICATION:
I certify that to the best of my knowledge the above report is complete and correct. All material, equipment used, and work performed during this reporting period is in compliance with the contract plans and specifications except as noted above.

____
Name, SUXOS
EA Engineering, Science, and Technology Inc., PBC

Date:
Project No:
Report:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

QUALITY CONTROL DAILY REPORT (D-11)

REMEDIAL INVESTIGATION

Assateague Island FUDS, Maryland

INSPECTION RESULTS:

Item Description	Pass/Fail	Item Description	Pass/Fail
PPE		MSDS & Container Labeling per APP or SS	
Compliance with Approved SOP		UXO/MEC Precautions Observed	
Compliance with Approved Safety Plan		UXO/MEC Disposal Operations	
Safety/Support Equipment		Motor Vehicles/ MHE	
On-site and Off-site Communications		Areas Inspected	
Explosives/Ordnance Reference Materials			

QA/QC Grid/Transect Status

Clearance Phase	Grid/ Transect	QA/QC Status

Seed Results

Clearance Phase	Grid/ Transect	QA Seed Serial #	QC Seed Serial #

QC Inspections:

Summary of Deficiencies:

Date:
Project No:
Report:

Corrective Actions:

Reinspection Results:

Additional Notes:

CONTRACTOR'S VERIFICATION:

I acknowledge that I have been briefed on the results of this inspection and will take corrective actions (if necessary).

____
UXOSO
Company

____
SUXOS
Company

Note: Safety Inspections are to be conducted and documented on this form. This form will also be used to document the present status of the site/site operations, and will also be used to note the current status of deficiencies note during daily inspections. Any daily inspection forms where deficiencies have been noted will be forwarded to the Site Manager and the Corporate QA/QC Manager.

Date:
Project No:
Report:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

SAFETY INSPECTION DAILY REPORT (D-12)

REMEDIAL INVESTIGATION

Assateague Island FUDS, Maryland

INSPECTION RESULTS:

Item Description	Pass/Fail	Item Description	Pass/Fail
PPE		MSDS & Container Labeling per APP or SS	
Compliance with Approved SOP		UXO/MEC Precautions Observed	
Compliance with Approved Safety Plan		UXO/MEC Disposal Operations	
Safety/Support Equipment		Motor Vehicles/ MHE	
On-site and Off-site Communications		First Aid Kit/ Trauma Kit	
Explosives/Ordnance Reference Materials			

Safety Inspections:

Summary of Deficiencies:

Corrective Actions:

Reinspection Results:

Date:
Project No:
Report:

Additional Notes:

CONTRACTOR'S VERIFICATION:

I acknowledge that I have been briefed on the results of this inspection and will take corrective actions (if necessary).

____
UXOSO
Company

____
SUXOS
Company

Note: Safety Inspections are to be conducted and documented on this form. This form will also be used to document the present status of the site/site operations, and will also be used to note the current status of deficiencies note during daily inspections. Any daily inspection forms where deficiencies have been noted will be forwarded to the Site Manager and the Corporate QA/QC Manager.

Field Change Request (FCR) Form (D-13)		
FCR #:	**DATE:**	
PROJECT NAME:	**USACE REP:**	
1. Description (Items involved, submit sketch, if applicable): (Use continuation sheet if necessary)		
2. Reason for Change (Use continuation sheet if necessary)		
3. Recommended Disposition (Submit sketch, if applicable): (Use continuation sheet if necessary)		
Preparer of FCR (Print name and sign)	Preparer's Title	Date
PM- Reviewed (Print name and sign)	Accepted (Y/N)	Date
QCM – Reviewed (Print name and sign)	Accepted (Y/N)	Date
SUXOS – Reviewed (Print name and sign)	Accepted (Y/N)	Date
USACE – Reviewed (Print name and sign)	Accepted (Y/N)	Date

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VEHICLE SAFETY INSPECTION CHECKLIST (D-14)

Vehicle ID: ______________________ Date: ______________________

Vehicle Name: ______________________ Inspector's Name: ______________________

Item Inspected	Check if Satisfactory	Comments
Brakes		
Parking System (hand brake)		
Tires		
Horn		
Steering mechanism		
Coupling devices (trailer hitch)		
Seat belts		
Operating controls		
Safety devices:		
Backup alarms		
Fire extinguisher		
First-aid kits		
Flares, reflective markers, or equivalent		
Accessories including lights, reflectors, windshield wipers, and defrosters where such equipment is necessary		
Inspection, test, repair, and maintenance records shall be maintained (available upon request)		
Oil (level, no leaks)		
General condition		
Lights (including trailer, if applicable):		
Headlights		
Taillights		
Turn signals (both front and back)		

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DAILY REPORT (D-15) – Assateague Island Remedial Investigation

DATE:

REPORT NO.:

Note: This form is to be completed in lieu of a SUXOS Dailey Report when the SUXOS is not onsite.

CONTRACT NUMBER AND NAME OF CONTRACTOR:
Contract #: W912DR-13-D-0018/DO 0006
EA Engineering, Science, and Technology, Inc., PBC (EA)
EA Project No: 62732.06

DESCRIPTION OF WORK:

LOCATION OF THE WORK:

1a. CONTRACTOR/SUBCONTRACTORS AND AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY:

Contractor - EA Engineering Science and Technology, Inc., PBC (EA)

Personnel/Position/Hours Onsite

Subcontractor –

Personnel/Position/Hours Onsite

Subcontractor –

Personnel/Position/Hours Onsite

Subcontractor –

Personnel/Position/Hours Onsite

USACE Oversight **–**

See attached daily sign-in log.

1b. WORK PERFORMED TODAY:

1c. EQUIPMENT USED:

2. TYPE AND RESULTS OF INSPECTION:

3. TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS OF TESTS *(i.e. field testing, calibration testing etc.):*

4. VERBAL INSTRUCTIONS RECEIVED (*List any instructions given by Government personnel on deficiencies, Additional testing required, etc., with action to be taken):*

5. REMARKS *(Cover any conflicts or changes in plans, specifications, or instructions: changes to surveying protocols, survey areas, or field findings, acceptability of incoming equipment; progress of work, delays, causes, and extent thereof; days of no work with reasons for same):*

Daily Report

6. VISITORS TO THE SITE *(List the name of all official visitors to the site and who they represent):*

7. HEALTH and SAFETY: (*Include levels of protection, activities completed, and all infractions of the accident prevention plan; or instructions from Government QA personnel. Describe corrective actions taken.*)

Safety meeting held today? ☐ Yes, ☐ No (If Yes, state the subject and report number of personnel in attendance)

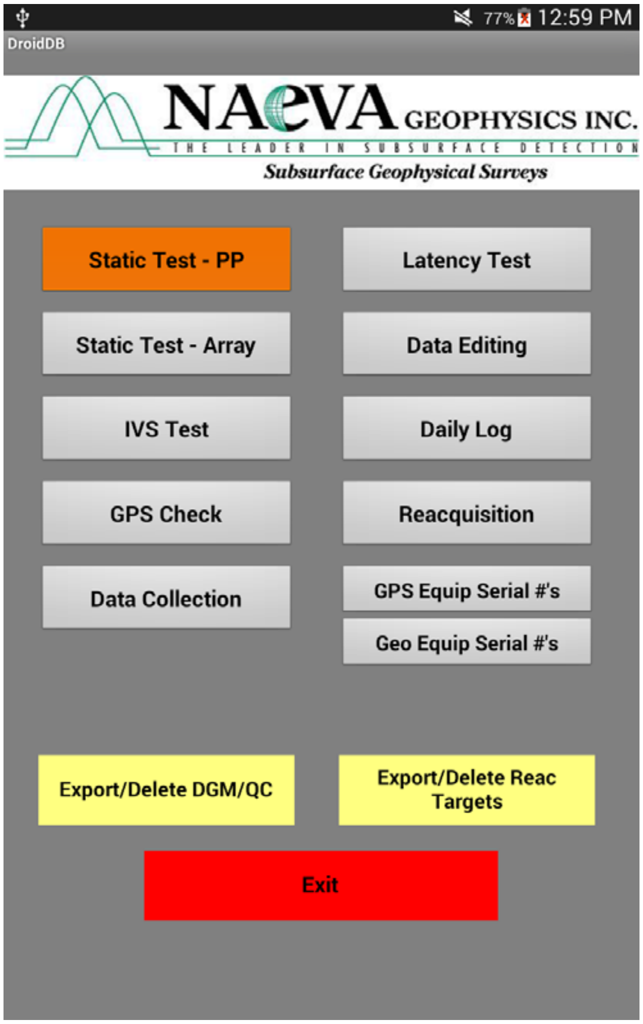
Number of Contractor personnel attending = Number of subcontractor personnel attending =

8. WASTE MATERIAL: (*Include quantities of materials)*

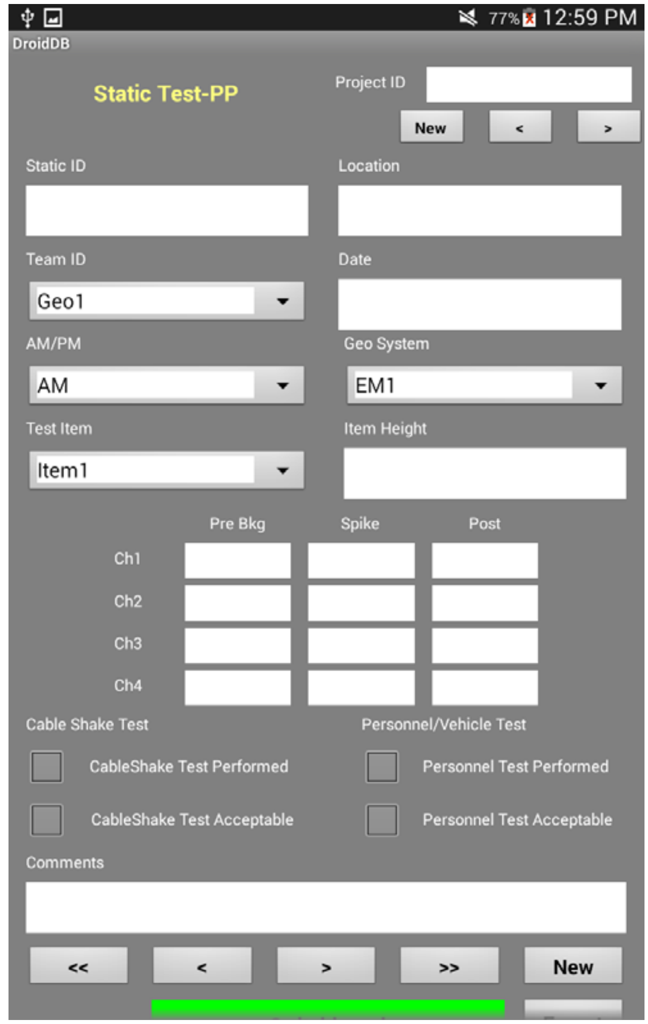
9. TOMORROW'S EXPECTATIONS:

CONTRACTOR's CERTIFICATION: I certify that the above report is complete and correct and that all material and equipment used, work performed, and tests conducted during this reporting period were in compliance with the contract except as noted above.

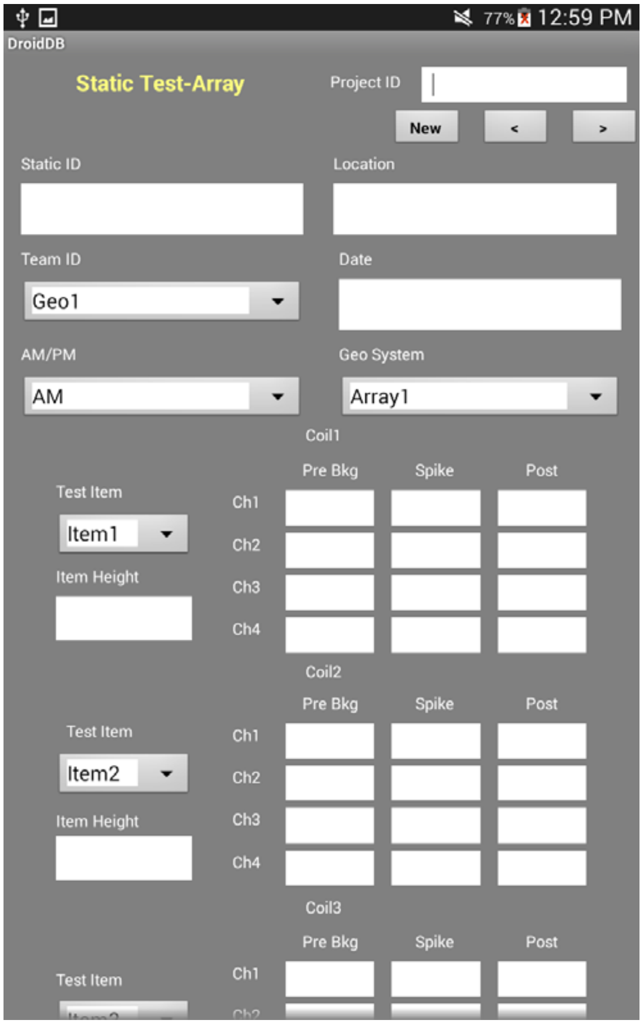
____
Contractor's Authorized Representative Signature and Date



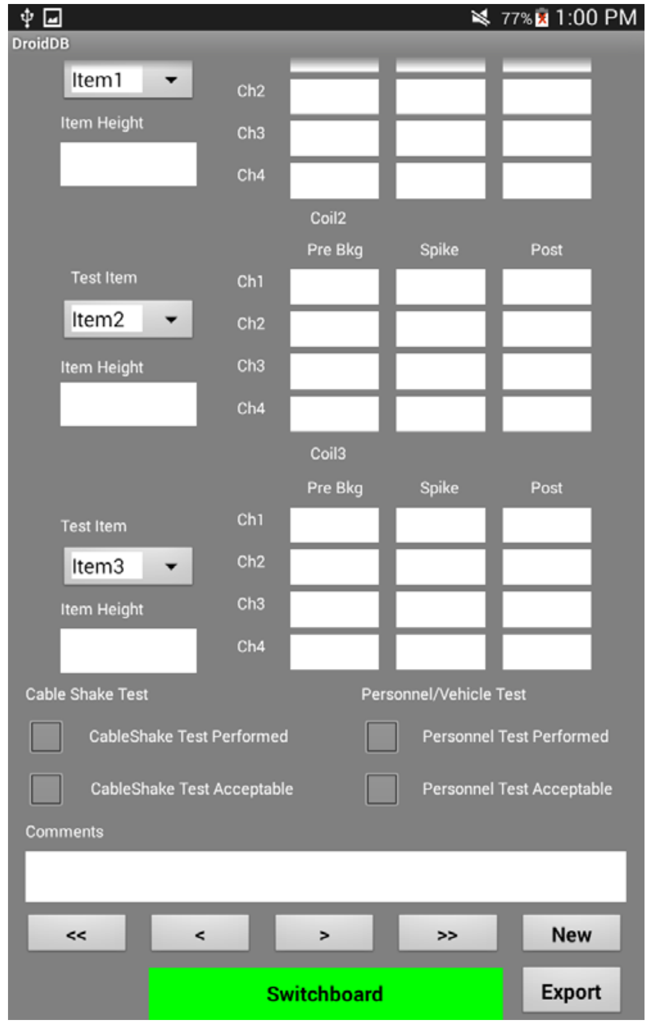
Main Menu



Static – Person Portable

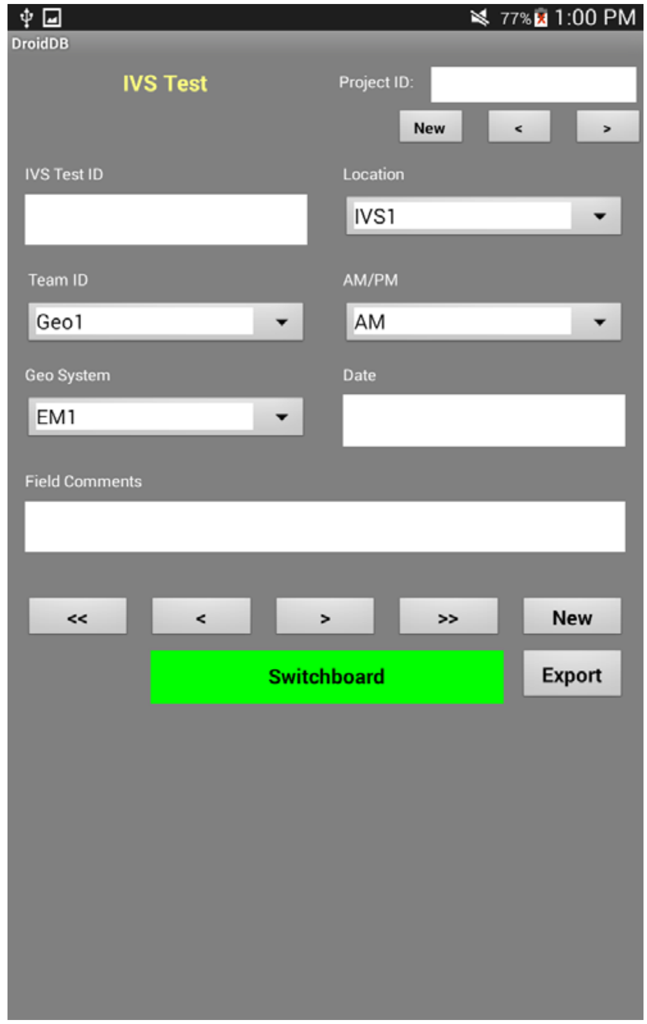


Static Test – Array Top of Form

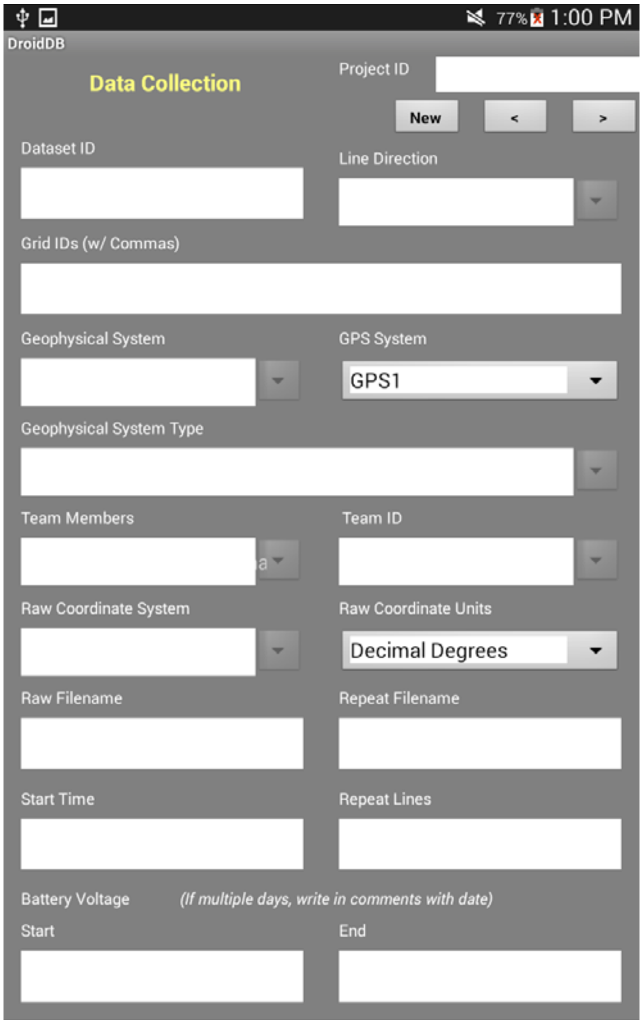


Static Test – Array Bottom of Form

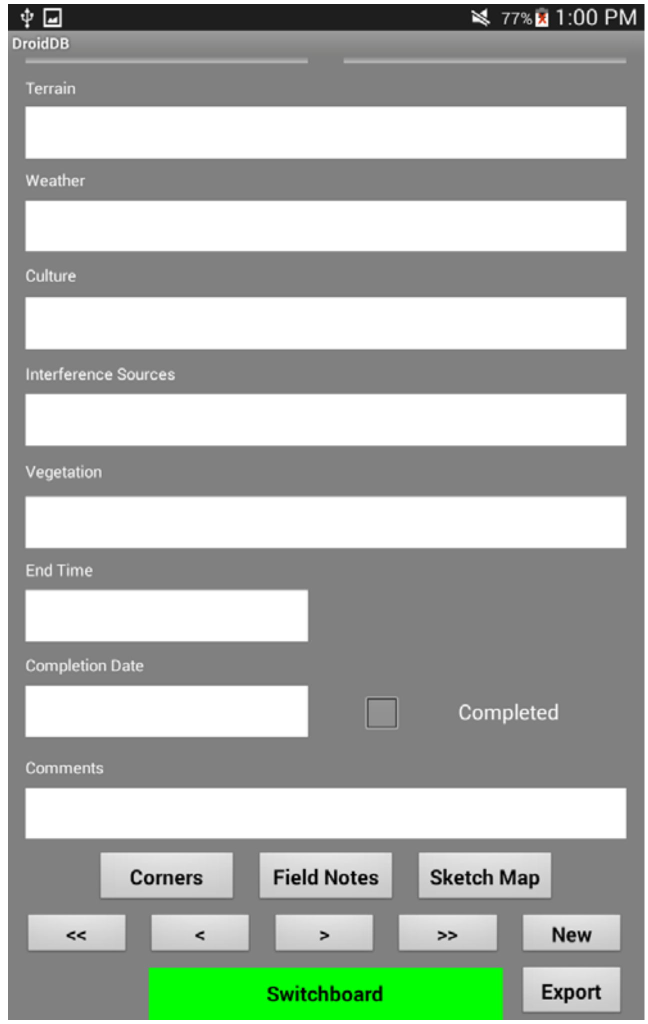
GPS Check Form



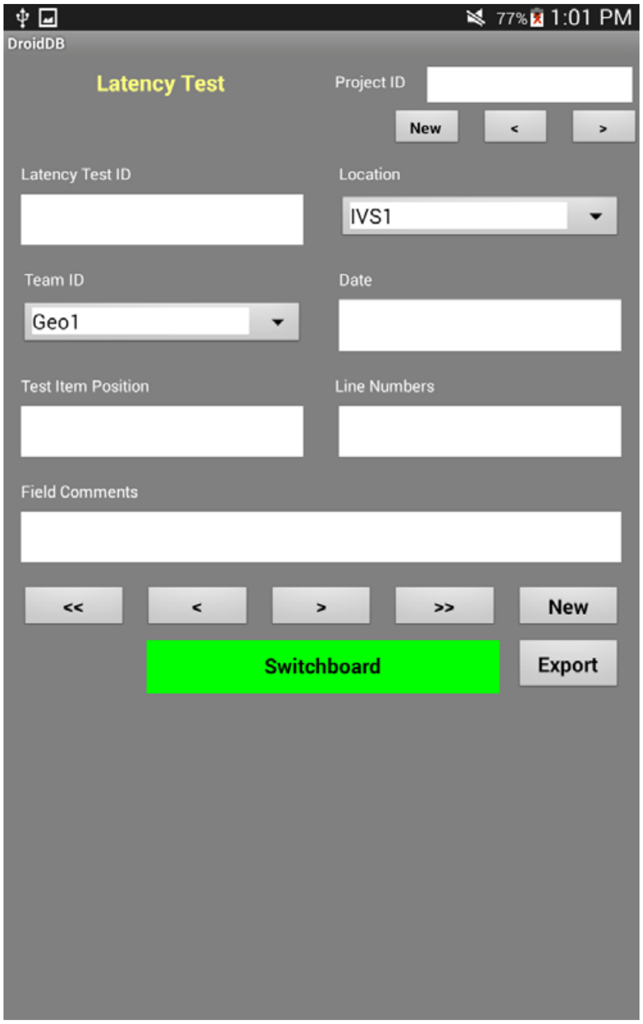
IVS Test Form



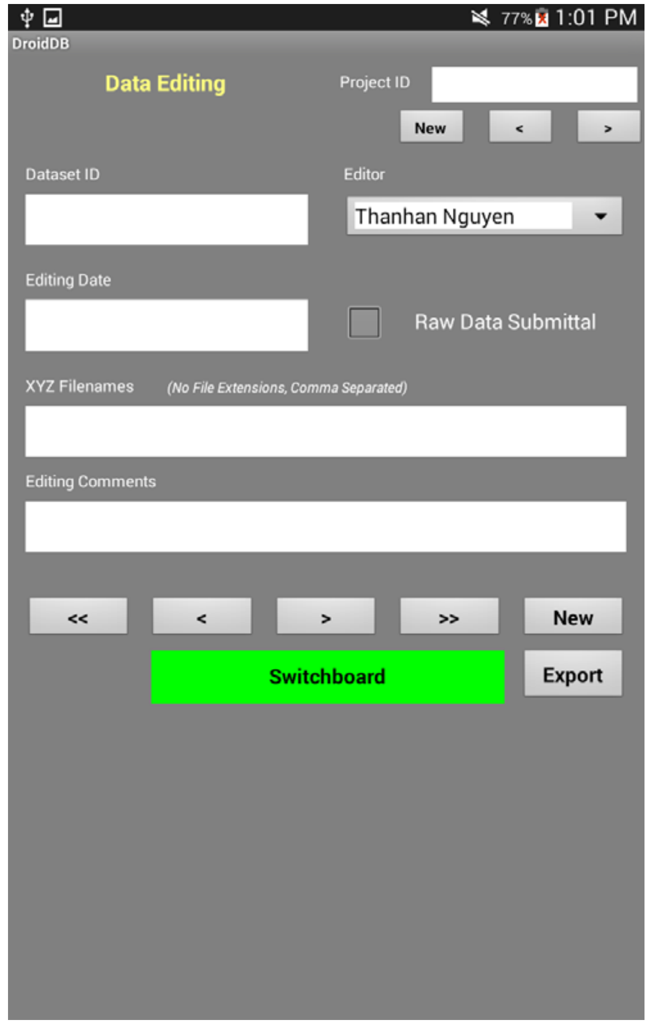
Collection – Array Top of Form



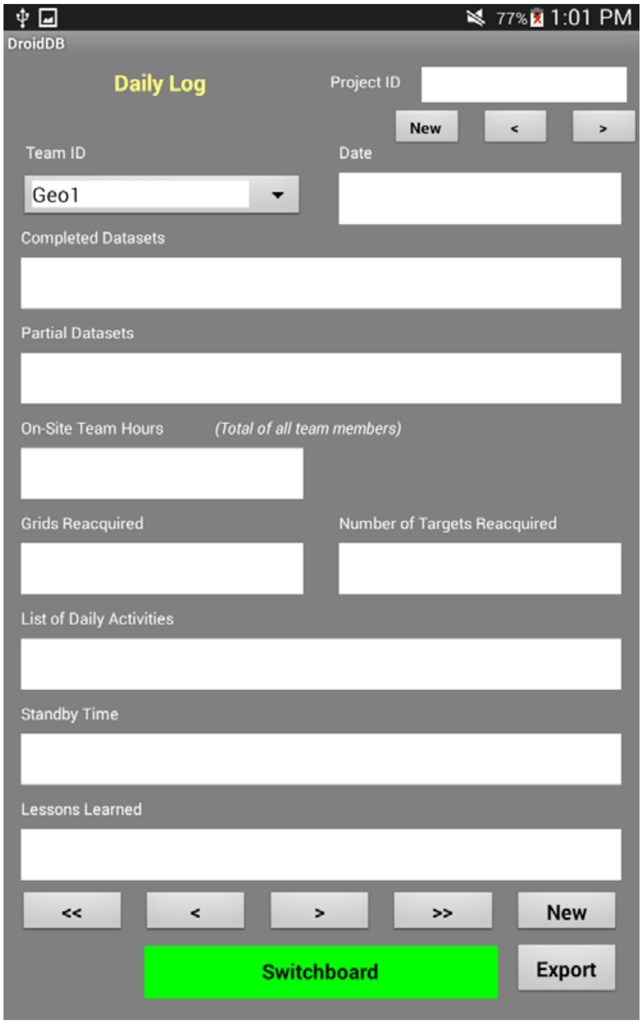
Collection – Array Bottom of Form

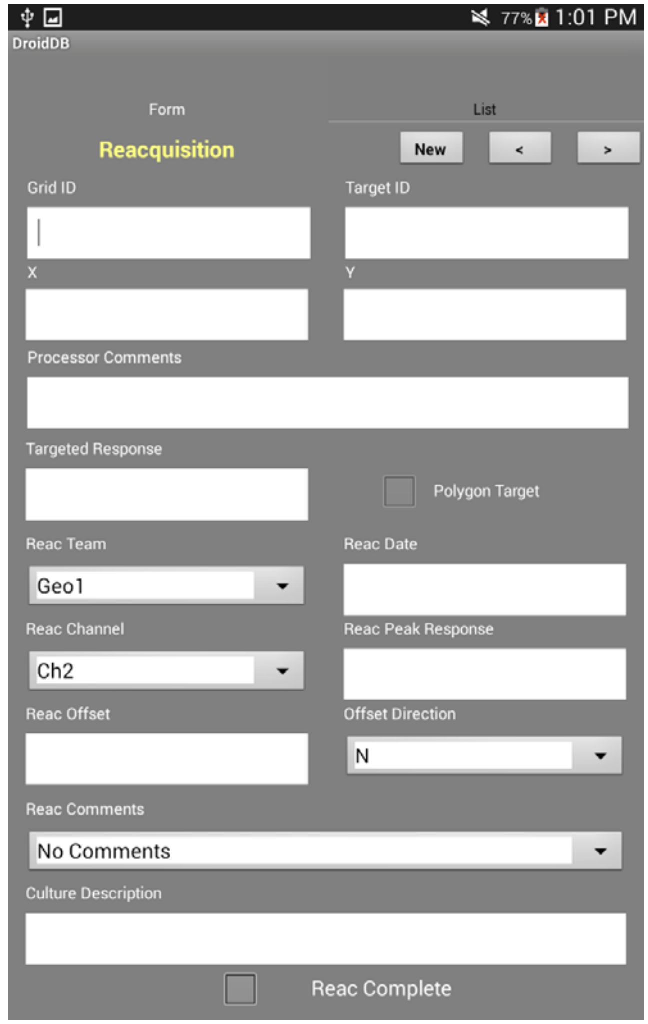


Latency Test Form



Data Editing Form

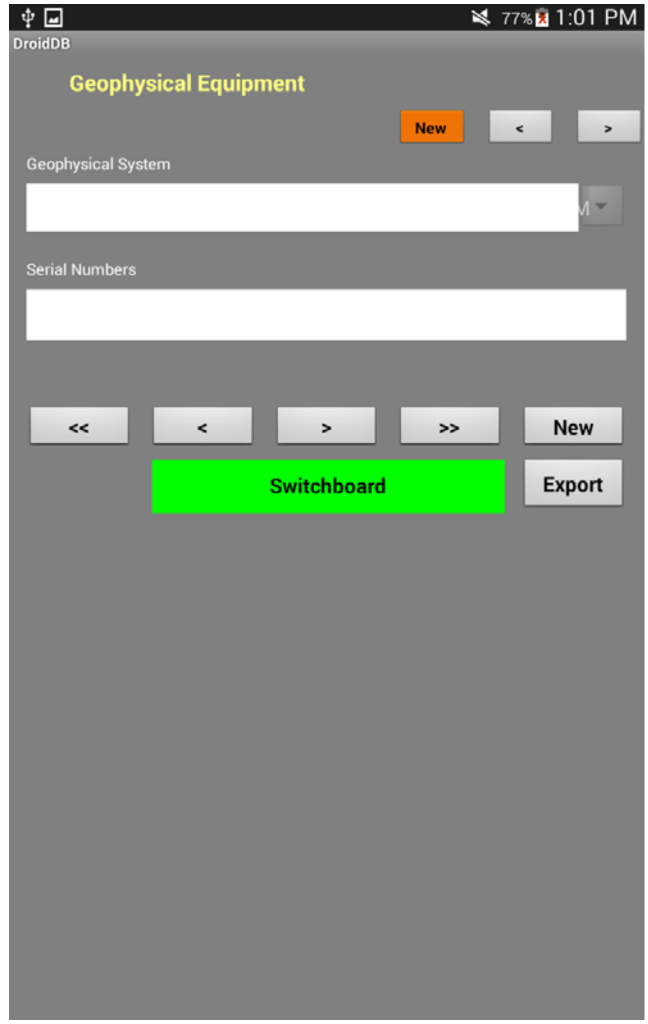




Daily Log Form

Reacquisition Form

Positioning Equipment Form



Geophysical Equipment Form

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