Statement of Work (SOW) Template

for

Remedial Investigation and Feasibility Study (RI/FS)

at a

Munitions Response Site (MRS)

FOR OFFICIAL DON USE ONLY **[INSERT DATE]**

Department of the Navy

NAVFAC [fill in the appropriate FEC]

Statement of Work (SOW)

Contract Number:

The statement of work shall be as outlined below and as described elsewhere in the basic contract number [insert].

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

MUNITIONS RESPONSE PROGRAM (MRP)

[Insert Installation/Site Name]

RPM Note: Please refer to the Remedial Project Manager (RPM) Notes provided throughout this template and delete all notes prior to finalizing the SOW. As used in this document, the term Munitions and Explosives of Concern (MEC) includes Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and Munitions Constituents (MC) (e.g., TNT, RDX) in high enough concentrations to pose an explosive hazard. Munitions Constituents (MC) are defined as materials originating from UXO, DMM or other military munitions, including explosive and non-explosive materials, and emission, degradation or breakdown elements of such ordnance or munitions. Include the specific definitions from the introduction if needed. The CECOS Munitions Response Site Management course maintains a list of definitions that are relevant to the Munitions Response Program. Obtain the latest course CD from a coworker or CECOS if additional definitions are needed.

Text highlighted in yellow indicates where you need to provide information specific to your project.

You will want to consider if you need a separate SOW for the planning phase prior to scoping and awarding a contract for the field work. It is important to ensure that your stakeholders are in agreement with the planned approach.

Reference information is available at the Munitions Response Workgroup web portal at https://portal.navfac.navy.mil/portal/page/portal/NAVFAC/NAVFAC_WW_PP/NAVFAC_NFESC_PP/ENVIRONMENTAL/ERB/MRP

As a reminder, the RPM must update the Munitions Response Site Prioritization Protocol (MRSPP) priority in NORM if any of the following circumstances are met:

• Upon completion of a response action that changes the conditions of a Munitions Response Site (MRS) in a manner that could affect the evaluation under this Protocol;

• To update or validate a previous evaluation of an MRS when new information is available;

• To update or validate the priority assigned (to an MRS) where that priority has been previously assigned based on evaluation of only one or two of the three hazard evaluation modules;

• Upon further delineation and characterization of an Munitions Response Area (MRA) into more than a single MRS; or

• To categorize any MRS previously classified as "evaluation pending."

The Protocol is only required to be reapplied once sufficient new data are available. If no new data are available at the time of annual review, the Protocol need not be reapplied. See the Munitions Response Site Prioritization Primer for more details.

1.0 OBJECTIVE

The objective for this task order is to perform a Remedial Investigation (RI) [and Feasibility Study] (FS) to address the past use of Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC) for a Munitions Response Site(s) (MRS) [insert the site specific identifier] at [insert installation, City, State].

The purpose of this Remedial Investigation and Feasibility Study (RI/FS) is to determine the nature and extent of the hazard/threat presented by MEC/MC contamination at [Insert Site] and, if sufficient need is documented by site sampling, perform an explosives safety hazard assessment, and a MC risk assessment, and evaluate proposed MEC/MC remedies. Integrating the development of the RI and FS is important to ensure that data obtained in the RI is appropriate to evaluate likely remedial alternatives during the FS. The contractor shall determine the nature and extent of the release of MEC/MC at the site, provide data for the explosive safety hazard assessment/MC risk assessment, perform the hazard/risk assessment, and collect sufficient data to develop and evaluate potential remedial alternatives as necessary and to recommend a preferred alternative for those areas of concern (AOC) within the MRS that have been determined to present an unacceptable explosive safety hazard or risk.

This action will be performed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Sections 104 and 121; Executive Order 12580; and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). [RPM to identify other regulatory drivers for this project.]

2.0 SCOPE

The scope of this Task Order is to conduct all work required to complete the final RI/FS Report for the site with Navy and regulatory concurrence. Details of this scope are further defined in Section 4. All work must be performed following applicable and appropriate Department of Defense (DOD) guidance and policy for Munitions Response Program (MRP) response actions and consider all site documentation and reports to date. The RI for this site shall consist of field investigations, including [geophysical surveys, intrusive investigation, MC sampling, etc] to characterize the nature and extent of MEC and MC (e.g., compound, affected medium, level of

contamination, extent of area affected, etc.) sufficient to assess the extent to which the MEC and MC poses an explosive safety hazard or risk to human health and the environment and to support the analysis and design of potential response actions if the site poses an unacceptable explosive hazard or health risk. The RI will provide a basis for decisions on further response actions or no further action (NFA). An MEC explosives safety hazard assessment (MEC HA) shall be conducted as part of the RI. Guidance in conducting the MEC HA can be found in the Munitions And Explosives Of Concern Hazard Assessment Methodology (EPA/DoD/DoI, February 2010).

RPM Note: To address explosive safety hazards from MEC, which includes MC at a high enough concentration to pose an explosive hazard, the DoD, EPA, Department of Interior (DOI), and state and tribal organizations developed the MEC Hazard Assessments (MEC HA) Methodology (most current revision, Feb 2010, is noted above). It qualitatively addresses human health and safety concerns associated with potential exposure to MEC and serves two main purposes:

1) To support the hazard management decision-making process by analyzing site-specific information to evaluate removal and remedial alternatives, and to assess land use activity decisions; and

2) To support the communication of hazards between members of the project team and among other stakeholders, and by organizing site information in a consistent manner.

In the Spring of 2009 OSD, Department of the Army, and DON agreed to the use of the MEC HA Methodology under a two-year trial period. The CNO letter of 6 Apr 09 states that for each RI/FS, the RPM shall evaluate this tool and decide, along with their regulatory and stakeholder partners, whether the MEC HA methodology is appropriate for the specific site. Furthermore, where the team decides to implement this tool, further evaluation shall be required regarding the outcome and effectiveness from implementation of this tool. Contact your FEC MR workgroup member for the MEC HA evaluation form to use in this evaluation.

Along with the MEC HA guidance document, RPMs may find it useful to review MEC HAs that have already been developed for other MRSs.

The risk assessment from exposure to MCs below a concentration to pose an explosive hazard should follow the Navy's tiered approach for both the Human Health Risk Assessment and the Ecological Risk Assessment. The relevant Navy Policies are: "Conducting Human Health Risk Assessments Under the Environmental Restoration Program" (Ser N453E/10595168, 12 Feb. 2001); and "Navy Policy for Conducting Ecological Risk Assessments" (Ser N453E/9U595355, 05 Apr. 1999). Navy guidance for conducting a human health risk assessment is provided in "U.S. Navy Human Health Risk Assessment Guidance", December 2008. Navy guidance for conducting an ecological risk assessment is provided online at http://www.nmcphc.med.navy.mil/downloads/ep/Risk%20Assessment/Chapters%201-12.pdf ***. If the RI/FS is only intended to address the explosive hazard, remove the MC risk assessment language from this SOW.***

The RI shall use the existing site information to accomplish the following:

- Develop a Work Plan for collecting necessary field data and other project plans

- Establish Data Quality Objectives (DQOs) for your site in coordination with stakeholders (see U.S.E.P.A. Guidance on Systematic Planning Using the DQO Process (EPA QA/G-4, 2006)
- Based on established DQOs for the project, select the appropriate detection technology and anomaly investigation approach for MEC/MC (e.g. Digital Geophysical Mapping (DGM), Mag & Flag.)
- Identify the appropriate MEC investigation design and depth based on the current, determined, or reasonably anticipated future land use (e.g. USACOE 11x rule)
- Develop an Explosives Safety Submission (ESS) for Naval Ordnance Safety and Security Activity (NOSSA) or Marine Corps Systems Command (MARCORSYSCOM) endorsement and Department of Defense Explosives Safety Board (DDESB) approval

RPM Note: A general rule of thumb developed by the USACOE for MEC detectors is that they can detect MEC at depths <11 times the MEC item's diameter. Figure 1 at the end of this SOW template helps illustrate this point. RPMs can use this information to get a rough idea of the depth of detection for the MEC investigation. The geophysical system verification instrument test strip and blind seeds will identify the actual site performance that is achievable. The RPM note for section 3.5.2 discusses the geophysical system verification in more detail.

The RI contractor shall then:

- Conduct the field work and assess the data collected to characterize the site
  - Perform an explosives safety hazard assessment and a MC risk assessment considering MEC/MC findings, access, land uses, and regulatory input which will provide a basis for decisions on further response actions or no further action (NFA)
  - Update the Conceptual Site Model (CSM) based on the site information and form the basis for the development of Remedial Action (RA) Objectives

The overall objective of the FS is to develop and evaluate potential remedies that permanently and significantly reduce the hazard/threat to public health, welfare, and the environment using the nine criteria established by CERCLA for remedy selection [40 CFR 300.430(e)(9)(iii)]. These criteria are:

- Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long Term Effectiveness and Permanence
- Reduction of Toxicity
- Short Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

The FS shall use the data generated from the RI, with input from the MEC HA and MC risk assessments, to accomplish the following:

- Develop and Screen Remediation Alternatives for Effectiveness, Implementability and Cost

    - Identify the appropriate remedy alternatives to consider (e.g. detection and anomaly removal, excavation and sifting, land use controls, etc.)
    - Identify the appropriate removal depth based on data from the site, the MEC HA and MC risk assessments, and the future land use
    - Assemble the remedies into alternatives and screen the alternatives as necessary, to reduce the overall number of alternatives to be forwarded for more detailed analysis.
    - Identify ARARs
- Conduct a detailed analysis of remedial alternatives
    - Refine the alternatives further, as necessary
    - Analyze the alternatives against the nine NCP criteria, the MEC HA and MC risk assessments
    - Compare the alternatives against each other

Based on the alternative analysis performed in the FS, the Navy, with regulatory coordination, will select a proposed remedy that will be described in a Proposed Plan for public review and comment. Comments and input obtained on the Proposed Plan will be addressed as necessary during the development of a Record of Decision (ROD) or other Decision Document (DD) that will define response requirements for the MRS or AOCs within the site.

RPM Note: The details for scoping a Proposed Plan and Record of Decision are not included in this scope, but the RPM can choose to add it if it is appropriate for your site.

Depending on the specific need at the site, a Community Relations Plan (CRP) may also be developed as part of this SOW. If not developed under this SOW, a CRP should be provided to support this and other phases of the MRP at the site. The CRP will:

- Provide the public an opportunity to express comments on and provide input to technical decisions;
- Inform the public of planned and ongoing actions; and
- Help identify and resolve conflicts.

3.0 SITE BACKGROUND

3.1 Location

[Describe the location of the site and provide a brief description of the terrain and vegetation, any existing buildings or infrastructure, photo(s), and any other information to help describe the general location and attributes for the study area. Provide references (if available) to reports or other information that would be relevant to the level of effort required to complete tasks, such as geophysical surveys and intrusive investigation, that are assumed to be part of the RI.

3.2 History

[Provide a brief history of the site and the reasons, known or suspected, for the potential presence of MEC/MC. Add subsections if there are specific areas of known MEC/MC and describe the types of munitions and filler if known. Include information on the source of MEC/MC at each site (disposal, range, manufacturing, etc). Depending on the extent of information available concerning the site, it may be appropriate to reference existing reports or documents rather than providing a complete summary in the SOW].

RPM Note: The RPM should be clear in these sections whether the site undergoing the RI/FS is an MRA, MRS or multiple MRSs. This general breakdown should have resulted from the PA/SI phase and the contractor will need to understand the limits of the study. The Navy may only be interested in remediating a single MRS within an MRA that contains multiple sites and this point should be clear in this SOW.

It is important to state the pertinent MEC use history including the types of munitions used, types of operations (e.g., OB/OD activities, firing points, impact areas, etc.), past findings, Archive Search Reports (ASR) results, past response actions, military Explosives Ordnance Disposal (EOD) unit reports, expected munitions, expected depths and extents if established, as well as any other pertinent information on MEC uses at the site from the PA/SI reports. RPMs are encouraged to reference pertinent reports or documents that detail the history of the site and the degree of information available concerning MEC incidence at the site. For ranges, it is important to provide any known information on firing lines and target locations as well as the types of munitions used at the site. The penetration depth will be a key factor in developing your detection and clearance criteria. For non range sites, you should consider any other information that may determine the maximum depth that MEC is anticipated to be found. This can be based on geology, land filling activities, historic documents or various other sources. While this is not always available, it can be very useful in focusing the investigation.

3.3 Safety

MEC represents a safety hazard and may constitute an imminent and substantial endangerment to personnel and the local population due to its explosive potential. All activities involving work in areas potentially containing MEC hazards shall be conducted only after receiving the endorsement of NOSSA/MARCORSYSCOM and the approval of the DDESB. NOSSA and MARCORSYSCOM are designated by OPNAV 8020.15/MCO 8020.13 to provide review and oversight of their respective munitions response projects. Details regarding explosives safety criteria for both Services are contained in NAVSEA Ordnance Pamphlet (OP) 5. Details regarding munitions response actions are contained in NOSSAINST 8020.15(series), Enclosure (3) of which describes how to write an Explosives Safety Submission (ESS). The contractor will perform all work in accordance with the approved ESS. Non-intrusive work done at an MEC site, outside of an ESS, will require a NOSSA/MARCORSYSCM determination that an ESS is not required per NOSSAINST 8020.15 (series), Enclosure (2).

RPM Note: OP 5, Vol. 1 and NOSSAINST 8020.15(series) are the two key documents that will govern explosives safety on DON sites. Marine Corps sites may follow this instruction with the approval of COMMARCORYSCOM (PM Ammo). Technical Paper (TP) 18 from DDESB provides the personnel qualifications and experience requirements for the contracted UXO personnel who will be performing the work. Work that includes the intentional contact with MEC, or intrusive operations in areas known or suspected to contain MEC, will require review and endorsement of an ESS by NOSSA/MARCORSYSCOM and approval by the DDESB. A separate site approval request is not required, but is part of the ESS. Up to a 6-month lead time is required for NOSSA/MARCORSYSCOM review and DDESB approval of an ESS and must be considered in scheduling of the RI. Advance notification to NOSSA/MARCORSYSCOM of an anticipated ESS is encouraged to expedite reviews and revision necessary prior to approval. The RPM should work closely with the MRP Work Group member for advice on MRP projects. NOSSA's phone number is 301-744-4450. MARCORSYSCOM's phone

number is 703-432-4824. A discussion of the requirements for an ESS is provided in sections covering intrusive work.

3.4 Chemical Warfare Material (CWM)

The site is not suspected to contain Chemical Warfare Materiel (CWM). However, if suspect CWM is encountered during any phase of site activities, the contractor shall immediately withdraw upwind from the work area, secure the site and contact the Navy RPM. The contractor shall maintain site security until written direction is provided by the Navy regarding the procedure to be followed for performing further RI/FS work at the site. The RPM will coordinate with NOSSA/MARCORSYSCOM.

RPM Note: It is assumed the CWM is not expected to be encountered at most MRP sites and that this disclaimer is appropriate. The level of planning and protective measures required for projects that may result in encounters with CWM is significantly greater than projects without CWM.

3.5 Sites with Potential MEC/MC

3.5.1 Site 1

[Site 1, Former (OB/OD, Bombing, Firing, Small Arms, etc.) Range, comprises XYZ acres and is located in the (where) portion of the MRA. It was used for (destruction of military munitions including small arms, pyrotechnics, white phosphorus (WP), rockets, grenades and artillery ammunition, bombing practice, etc.) for X years. Describe the circumstances surrounding the MEC/MC activities in sufficient detail so that the bidders will understand the circumstances of the site. According to the PA/SI, historical records review, etc., the following MEC/MC are associated with this site:

- Small Arms
- Pyrotechnics
- Everything else in the inventory

[Provide a description of the property, for example: The property is (hilly, relatively flat, mountainous, etc.) with (dense, sparse, etc.) vegetation. A creek runs through the property from SE to NW and the land on either side of the creek for approximately 100 feet is very wet and cannot be traversed by vehicle. etc. Include a description of any manmade infrastructure that is on the property.]

3.5.2 Site 2

[Same information for each of multiple sites, if multiple sites are part of the RI]

RPM Note: The purpose for the site descriptions is to provide the contractor with as clear a picture of the property as possible. A description of the MEC activities is essential so that they can evaluate the best possible investigation techniques to recommend. A list of the types of MEC is necessary to determine which detection technology (e.g., magnetometer, electromagnetic (EM), or other) will perform the best. The description of the property and infrastructure is necessary to evaluate what sort of platform (e.g., man

portable, towed, other) to use to transport the geophysical sensors and which type of positioning (e.g., GPS, fiducial, other) may be most effective. It is also important for the RPM to determine if the site will have to be cleared of vegetation prior to field work.

The RPM is encouraged to provide references to documents and information that may provide a more detailed account of site conditions and history than can be provided in the site description in the SOW. In addition, a scoping meeting should be included with the contractor prior to their development of a proposal to allow the contractor to obtain all necessary data for development of the proposal. In the event that data necessary to accurately estimate the level of effort to perform the RI is not available (e.g., number of anomalies per acre in the site) the RPM and contractor should agree to the assumptions that will be used in development of the proposal.

The selection of the most appropriate MEC detection technology for conducting a response action is not a simple task for two reasons: (1) there is not a currently accepted "best" tool that offers a high degree of effectiveness, ease of implementation, and cost-effectiveness in every situation; and (2) the "best" geophysical detector in one geological, topographical, and vegetative environment may not work well in a different environment. In the past, the accepted method for determining which is the best munitions detection technology for a particular MRS was to design and construct a geophysical prove-out (GPO) test bed and then test a variety of instruments on the GPO to determine their probability of detection and to establish a confidence level in that probability. This, however, is generally considered to be outdated and a GPO is not needed for most sites. The method now being advocated is the Geophysical System Verification (GSV) which is discussed in the following paragraphs.

Background information on detection technologies can be found in the* Survey of Munitions Response Technologies by ESTCP, ITRC, and SERDP; June 2006. *This document provides an overview of the current status of technologies used for munitions response (MR) actions and, where possible, evaluates and quantifies their performance capabilities. This document also provides project managers and regulators an understanding of the performance capabilities of available technologies under real-world site conditions and should be used in conjunction with the process for establishing project DQOs. Background information on the GSV can be found in* Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response by ESTCP; July 2009*.

The evaluation and cleanup of current and former military sites contaminated with buried munitions relies on two well-understood geophysical technologies to detect the munitions: magnetometry and electromagnetic (EM) induction. As these technologies were introduced in munitions response projects, the GPO was developed to determine whether the geophysical data collected would meet project objectives. Over the last 15 years, numerous GPOs have been performed on a variety of site conditions, and a significant body of knowledge has accumulated documenting the performance of these technologies. This accumulated understanding, along with the recognition that magnetic and EM responses of munitions may be predicted reliably using physical models, presents the opportunity for both streamlining and enhancing the GPO with a more

rigorous physics-based approach. ESTCP in collaboration with the military Services, state and federal regulators, and the National Association of Ordnance and Explosive Waste Contractors (NAOC) has designed a new approach, geophysical system verification (GSV), as a physics-based alternative to GPOs. Using the GSV process, the resources traditionally devoted to a GPO are reallocated to support simplified, but more rigorous, verification that a geophysical system is operating properly, as well as ongoing monitoring of production work. The two main elements are:

> ***1) An instrument verification strip (IVS) containing a handful of targets (pipe nipples of various sizes) replaces the traditional GPO, which consists of several tens to a hundred or more targets. The objective of the IVS is to verify on a daily basis that the geophysical survey system is operating properly. The IVS targets should be observed in the data with signals that are consistent with both measurements and physics-based model predictions. Adjacent measurements of the site noise are used to determine whether targets of interest can be detected reliably to their depth of interest under the site conditions.***
>
> ***2) In the blind seeding program, the production site is seeded with targets (pipe nipples) at surveyed locations that are blind to the data collection and processing teams. The objective 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.***

RPMs should note, however, that the GSV is not applicable to so-called "black boxes." This will include proprietary devices for which sensor details are not divulged and any other system whose operation, in terms of both hardware and processing, is not well-documented. Likewise, the GSV will not be appropriate for technologies based on completely different physical phenomena, where a GPO may be required. RPMs should also note that some aspects of the seeding will not be practical at all sites. For example, seeds may be difficult to apply to transects and meandering path surveys, where 100% survey coverage is not required and the exact locations of survey lines is not known in advance.

The Geophysical System Verification: A Physics-Based Alternative to Geophysical Prove-Outs ***document can be downloaded from the ESTCP website at www.estcp.org***

RI DOCUMENTS AND FIELD WORK

RPM Note: For sections 4.0 and 5.0 we have included below a list of the typical types of investigation/analysis an RPM may do at a MRP site during the RI/FS phase. The RPM should adapt this SOW from the parts outlined below and apply them to your specific site as needed. Each component is described in greater detail at the end of this SOW and should be cut and pasted in as needed. The documentation required for each component is highlighted below and described for each at the end of this SOW template. The hyperlinks to each section are below, just press the ctrl key and click to go to the relevant section.

The primary goals of the RI are to determine the nature and extent of contamination and to use this data to develop a baseline exposure assessment for the site. The exposure assessment considers potential threats to human health and the environment from site

contaminants (including MC) as well as potential exposure to explosive safety hazards at MRP Sites. The baseline exposure assessment is used to determine if an unacceptable health/ecological risk or explosive hazard exposure exists at the site. If an unacceptable risk or explosive hazard exposure is determined to exist, the FS evaluates the array of remediation alternatives that will be considered to address this situation and select the preferred alternative.

In developing the plans for the RI/FS, the RPM should follow guidance provided by* U.S. Environmental Protection Agency, 2006a, Guidance on Systematic Planning Using the Data Quality Objectives (DQO) Process (EPA QA/G-4)*. Use of this guidance will focus data collection activities included in the RI/FS to ensure that only data needed to support decision making an alternative analysis is collected and prevent needless expense and time collecting data that does not contribute to RI/FS objective.

The RPM should coordinate with stakeholders prior to developing this SOW to outline the site requirements and DQOs, which will help determine the most appropriate components to include for your site. In many cases, the process of determining the DQOs and defining the field data necessary to meet these objectives will require an extensive planning effort to ensure that input from regulatory agencies and stakeholders has been appropriately considered. This is particularly true for complex projects that are managed under Interagency Agreements with Federal and State regulatory agencies. At such sites, draft RI/FS work plans are commonly a primary deliverable requiring State and Federal regulatory agency approval prior to initiation of any RI/FS field work.

In cases where an extensive planning effort is required to develop the RI/FS work plans and define the DQOs and field work and data collection requirements for the RI and subsequent FS, the RPM should consider scoping the planning effort for development RI/FS work plans separately from execution of the work plans. Separate scoping of the work plan development phase of the project will allow the RPM and contractor to better define the field work that will be required to complete tasks identified in work plans that have been approved by regulatory agencies.

One issue that has appeared in developing plans for fieldwork is poor quality control of the initial document generated by the contractor. These plans should be reviewed by the contractor's quality control personnel prior to submission to the Navy. If obvious mistakes are included in these initial plans (e.g. SOPs copied and pasted from another project without any adjustment to the specific site, etc), the RPM should consider whether a contractor should receive a reduced award fee, or low evaluation score.

4.0 RI DOCUMENTS

RPM Note: The hyperlinks to each section are below in section 5.0, just press the ctrl key and click to go to the relevant section and edit, copy, paste in the relevant information.

5.0 RI FIELD WORK

Sampling for Munitions Constituents (MC)

Documents: RI Work Plan, HASP, FSAP, QAPP

Other issues: Anomaly avoidance measures, ESS determination

Geophysical Investigation without Intrusive Investigation

Documents: RI Work Plan, HASP, PQCP, GPO or GSV Plan

Other issues: Site preparation, Govt. QA Plan, anomaly avoidance measures, ESS determination

Geophysical Investigation with Intrusive Investigation

Documents: RI Work Plan, HASP, PQCP, GPO or GSV Plan, ESS
Other issues: Site preparation, Govt. QA Plan, MEC disposal plan, MPPEH management

Mag, Flag, & Dig (Magnetometer detection and marking without geophysical mapping followed by intrusive investigation)

Documents: RI Work Plan, HASP, PQCP, GPO or GSV Plan, ESS
Other issues: Site preparation, Govt. QA Plan, MEC disposal plan, MPPEH management

RPM Note: A MEC UFP-QAPP template is available on the MR portal. The template provides modified UFP-QAPP workheets with a discussion of the considerations necessary to generate a MEC UFP-QAPP. Likewise, an example MEC UFP-QAPP is provided on the MR Portal. Also included are the Technical Management Plan for the site and the Standard Operating Procedures which are appendices in the MEC UFP-QAPP. These documents are provided so that the level of detail that was developed in each document can be understood. The work plan contains a minimum amount of information with the purpose of directing the reader to the MEC UFP-QAPP.

A Quality Assessment SOW template is also on the MR Portal. This SOW template is intended to assist the RPM in contracting with either the Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV) or an independent third party to perform the Quality Assessment role during munitions response (MR) actions.

6.0 Treatability Study

RPM Note: A Treatability Study involves testing and evaluating a treatment technology to determine the effectiveness of that technology at a particular site or to establish site-specific design parameters. These studies can be applied to remedy screening, selection and design, and should be carefully selected to meet DQOs for the project. The additional costs for conducting treatability studies are often justifiable as these studies can significantly reduce the uncertainties that are sometimes associated with innovative technologies.

Treatability studies may be needed during the RI/FS when sufficient information for technology cost and performance, under site-specific conditions, is not available. This information is necessary for applying the nine NCP criteria for evaluation of alternatives for the feasibility study. A treatability study should verify whether the technology is capable of meeting the cleanup goals or other specified performance objectives.

Following a decade of research and development, classification technology of MEC has now been successfully demonstrated on several live sites under the Environmental Security Technology Certification Program (ESTCP). This new process is used to classify subsurface anomalies as those likely to be a MEC item which must be removed or is likely to be a non-MEC item which may be left in the ground. Using these advanced classification sensors to analyze data over previously-detected anomalies has shown

that it is possible to correctly identify 75-90+% of clutter while retaining all of the MEC on the dig list.

RPMs should consider if this technology is applicable at their site and perform a treatability study to define such things as production rate, areas that are suitable for classification technology, the overall economics of implementing the classification process, and the QA/QC requirements for the new sensors. More information on the classification technology can be found on the SERDP ESTCP website and in the guidance on their website titled "Implementing Advanced Classification on Munitions Response Sites: A Guide to Informed Decision Making For Project Managers, Regulators, and Contractors" It may be prudent to have a scoping meeting with the contractor to discuss which classification technology treatability studies will be performed and where they will be performed.

The objective of this treatability study is to determine if classification technology is a viable treatment option and can meet remedial action objectives for Site 1 or portions of Site 1. Activities associated with this project include the following:

- Development of a treatability study workplan. The workplan should, among other things, clearly describe: the experimental design, the treatability study goals, the QAPP, data management and interpretation, and reporting.
- Installation and development of appropriate QC processes and measures such as instrument verification strip and blind seeding with XXX size industry standard objects
- Collecting advanced geophysical sensor data over XXX anomalies using XYZ system;
- Processing the data, including feature extraction and classifier application to develop a "dig list"
- Conducting intrusive investigation to verify performance of the classification technology on XXX anomalies and manage any MEC/MPPEH derived from the study
- Performing a detailed analysis of classification technology alternatives including which advanced sensor is appropriate for the site areas and the estimated costs to implement the classification technology. The detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of the CERCLA nine evaluation criteria and a comparative analysis of all options against the evaluation criteria with respect to one another.
- Preparing a treatability summary report or appendix in the RI/FS report which documents the results of the treatability studies and QA/QC for the study

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The contractor shall use and refer to EPA guidance for this treatability study. Specifically, EPA's "Guide for Conducting Treatability Studies under CERCLA, 1992"

RPM Note: the above language assumes that an ESS is in place. If it isn't, modify the language to incorporate appropriate ESS development language from section 5.

7.0 RI/FS REPORTS and CRP

The results of the site characterization shall be documented in an RI/FS Report. The RI/FS report shall be submitted in preliminary/internal draft for Navy review, draft for full regulatory review, and final after comments are addressed. The contractor will develop a range of MEC/MC management alternatives that will remediate or control any MEC/MC remaining at the

site, as deemed necessary in the RI, the MEC HA, and the MC risk assessments to provide adequate explosives safety, and protection of human health and the environment. The potential alternatives should encompass, as appropriate, a range of alternatives in which MEC/MC removal is used to reduce the toxicity, mobility, or volume of MEC/MC but vary in the degree to which long-term management of residual/remaining MEC/MC is required. One or more alternatives involving land use controls and a no-action alternative should also be included.

The potential technologies and process options should be combined into location-specific or site-wide alternatives. The contractor will meet with the Navy to discuss which alternatives will be evaluated in the detailed analysis and to facilitate the identification of action-specific ARARs. The contractor will conduct a detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of the CERCLA nine evaluation criteria and a comparative analysis of all options against the evaluation criteria with respect to one another. The individual analysis should include: (1) a technical description of each alternative that outlines the MEC/MC management strategy involved and identifies the key ARARs associated with each alternative; and (2) a discussion that profiles the performance of that alternative with respect to each of the evaluation criteria. A table summarizing the results of this analysis should be prepared. Once the individual analysis is complete, the alternatives will be compared and contrasted to one another with respect to each of the evaluation criteria.

RPM Note: The RI report can be combined with the FS report to form an RI/FS report, but the RI and FS reports also can be submitted separately. The RI section of the RI/FS report should present the methods used for the RI, the updated CSM resulting from the investigation, the results of the MEC HA and MC risk assessment, a determination of whether further remedial action is needed, and if so, the recommended remedial action objectives. The primary focus of the FS report is to ensure that appropriate remedial alternatives are developed and evaluated in such a manner that the information can be presented to a decision-maker and an appropriate remedy selected. Development of alternatives shall be fully integrated with the site characterization activities of the RI, and the combined RI/FS leads to the selection of an optimal response action for the site.

The recommended format to follow for the RI and FS sections of the report are provided in Table 8-1and Table 8-3 of the Department of the Navy Environmental Restoration Program Manual. The RPM should direct the contractor to update this format to include MEC related information.

***The MEC Removal, Treatment and Residual Processing tables at the end of this document help to provide a list of available alternatives that may be evaluated in the FS. These tables are from the* USACOE, MEC Detection, Recovery, And Disposal Technology Assessment Report.**

Community Relations Plan (CRP)

The contractor will be responsible for setting up and documenting community interviews in order to produce the CRP. Interviews will be conducted with FEC personnel and local officials, residents, public interest groups, and other interested or affected parties to ascertain community concerns, community information needs, and how or when citizens would like to be involved in the CERCLA process. The contents of the CRP should include the following: background and history of community involvement at the site including local activity and interest plus key issues; site history including environmental history; objectives of the ER Program; community involvement activities to meet the ER Program objectives; and a list of officials,

citizen/community groups, and media contacts. The CRP shall be submitted in preliminary/internal draft for Navy review, draft for full regulatory review, and final after comments are addressed. The community involvement program shall be conducted in accordance with the RAB Rule (Federal Register 5/12/06) and the RAB Rule Handbook (DoD, March 2007).

RPM Note: The Community Relations Plan documents the history of community relations and the issues of community concern at a site. It describes the objectives of the community relations activities and how these objectives will be met and includes a discussion of planned community interviews, fact sheets, and public meetings. The Navy Environmental and Natural Resources Program Manual (OPNAVINST 5090.1B, 01 Nov.1994) and Marine Corps Environmental Compliance and Protection Manual (MCO P5090.2A, 10 July1998) and the RAB Rule Handbook (DoD, March 2007) provide public participation guidance.

DON's policy is to prepare CRPs for specific installations rather than for specific actions, the CRP may have additional requirements beyond those specified in CERCLA and, therefore, the RPM should check the installation's CRP to ensure that all requirements are being met. If necessary a CRP should be developed. Otherwise, community relations activities should support the existing CRPs (most cases).

8.0 PROJECT MANAGEMENT

The contractor shall perform project management activities necessary to maintain project control and to meet reporting requirements, including but not limited to the following:

8.1 Schedule

The contractor will prepare a comprehensive project schedule which shall be due within [insert weeks/months] after project award. The schedule will be prepared using MS Project and provided in hardcopy and electronically in native format and may be required as a .PDF file as well. The contractor shall update the schedule monthly and provide this as an electronic deliverable (email only for this electronic deliverable) to the RPM. The contractor shall coordinate critical deliverable dates with the RPM. [Insert any critical schedule requirements here, such as Federal Facility agreements or other agreements]

8.2 Meetings and Project Coordination

8.2.1 Pre-Bid and Kickoff Meetings

A pre-bid site visit [will/will not] be conducted by the Government. The pre-bid site visit will occur, [provide the date, time, assembly place, etc. for the visit]. The Government will prepare an abbreviated Site Safety and Health Plan to cover the site visit and, if the area has known MEC, provide a UXO-qualified safety escort. If necessary, a request for an ESS determination will be prepared by the government for submittal to NOSSA/MARCORSYSCOM prior to the site visit.

RPM Note: The need for a pre-bid site visit will depend on the information available from the PA and/or SI and the contractor's familiarity with the site and your selected contract

mechanism. A pre-bid site visit may be required for contract mechanisms where the SOW is sent to several bidders.

The contractor shall plan to attend a kickoff meeting/formal site visit at [insert site or Facilities Engineering Command (FEC)]. Attendees of this meeting may include the Navy RPM, Environmental Coordinators and others from the site and various FEC personnel. At a minimum, the contractor's Project Manager and/or Technical Lead for this project shall attend. Regulators and stakeholders may be included as determined by the RPM. The agenda for this meeting will include discussions of roles and responsibilities, emergency response, health and safety, access to the site, project schedule, explosives safety, contracted deliverables, investigation methodology, and other issues related to the delivery order. The contractor shall provide a written meeting agenda to all invited participants not less than [insert number of days] prior to the scheduled meeting, coordinate with the RPM to arrange meeting facilities, and provide invited participants written meeting minutes within [insert number of days] after the meeting.

8.2.2 Project Meetings

The contractor shall coordinate and attend [insert number] additional meetings at [insert location] to be held at the discretion of the RPM. Attendees normally include regulators and stakeholders. To the extent possible, it is recommended to schedule project meetings during times when the contractor's staff are already visiting [insert location] for project-related duties. Teleconference and web enabled meetings may also be necessary. The contractor is responsible for agendas and minutes of all meetings. The contractor will provide an agenda, via e-mail, no less than [insert number] days prior to any meeting to participants identified by the RPM. For meetings involving review of a deliverable, include a brief synopsis of the latest comments and recommendations for the deliverable. The contractor will provide invited participants written meeting minutes within [insert number] days after the meeting.

9.0 SUBMITTALS AND CORRESPONDENCE

9.1 Format for Reports

The final RI/FS Report shall consist of a black and white master adequate for printing and copying on 8 1/2" X 11" paper size. It is permissible to use foldout sheets as long as the eleven-inch vertical dimension is retained. Maps should be in color to easily distinguish the various features, however, the contractor must ensure that critical data are not lost if the map is reproduced in black and white. Deliverables, other than Draft, shall contain a "Response to Comments" (RTC) table indicating how each regulatory agency comment was addressed. All draft and final submittals must be letter quality; all pages must be numbered with chapter number followed by page number (1 1, 1 2, 1 3, 2 1, 2 2, 2 3, etc.). Appendix documentation submittals must be letter quality with all pages numbered (A 1, A 2, B 1, B 2 etc.).

9.2 Electronic Deliverables of Records

The electronic version/file of the preliminary/internal draft, draft, and final after comments are addressed shall be submitted in both A) the native format, which Navy prefers be a Microsoft product, and B) Adobe Acrobat PDF (or compatible) format. The PDF version of all final deliverables (other than raw analytical and databases) must be a complete, mirror image of the hardcopy, and include appendices, maps, signature pages, etc. At completion of the project with the Final RI/FS Report submittals, the contractor will provide an electronic deliverable with a copy of all reports, meeting minutes, point papers, maps and map databases, and briefings. All

electronic submittals will be certified “virus free” and include the statement “virus free” on the disk or transmittal message. The contractor shall verify, with the RPM, the appropriate data management requirements and electronic data deliverables.

9.3 Spatial and Non-Spatial Data Standards

RPM Note: NIRIS is designed to manage both IR and MRP site data using GIS and other end user tools. Training on the use of NIRIS is recommended and available upon request for both RPMs and contractors. Coordinate with your local NIRIS Workgroup member regarding access and training for NIRIS and mapping needs. In the fall 2012 timeframe, NIRIS will be linked to the Regional Shore Installation Management System (RSIMS) for local basemap data, real estate parcel information and aerial photography for most sites. All ER data must be submitted via the NIRIS Electronic Data Deliverables (NEDDs) and automated data checker. NIRIS should be used for MR projects mapping needs, however, if there is an existing, legacy system with data to migrate to NIRIS, or specialized applications or tools, talk to your local NIRIS Workgroup member. NIRIS is located on the NAVFAC Portal by navigating to the “employees” (i.e., Private Portal) side, clicking on “eTools”, clicking on “more eTools” and scrolling down to NIRIS.

Spatial data such as maps, CADD drawings, aerial photos, etc. may be required in support of the project. All CADD and Geographic Information Systems (GIS) graphics deliverables shall be compliant with the latest Navy and DOD spatial data requirements, i.e., Naval Installation Restoration Information Solution (NIRIS) Non-NEDD Deliverable Submittal Guidelines SOP).

9.4 Geographic Information Systems (GIS) Deliverables

MRP data is inherently spatial in nature. A web-based GIS shall be used to facilitate decision making, perform analysis and visualize results, to ensure effective cleanup decisions are made in cooperation with the Navy, regulators, and other stakeholders. GIS data may include: past and present land uses, site conditions, historical photographs, land use controls (LUCs), geophysical data, MEC findings data, and MC data collected throughout the RI/FS. The Government will provide the contractor access to NIRIS and provide the initial base mapping data and information on the format of the data. The NIRIS Non-NEDD Deliverable Submittal Guidelines SOP contains detailed requirements and specifications and should be used for all GIS deliverables.

The contractor shall update and manage the project GIS in NIRIS, or if needed, an export of the NIRIS data using a local machine running ArcGIS or ArcInfo. Any project related spatial data including maps, models and associated collected or created data must then be submitted back to NIRIS according to the NIRIS Non-NEDD Deliverable Submittal Guidelines SOP. This would include daily geophysical data, MEC related items found during the investigation, positively identified MEC, positively identified archeological sites, environmental sample locations, inaccessible areas such as brush piles, fence lines, areas of bare rock, etc.

9.5 Electronic Data Deliverables

All tabular data such as MC analytical results by location, geophysical anomaly or ordnance information shall be provided using the appropriate NIRIS Electronic Data Deliverable according to the NEDD Standard Operating Procedure using the NIRIS web-based data checker.

9.6 Administrative Record File (ARF)

The contractor will establish or maintain an ARF during this phase of the project. All documents will be prepared and indexed for inclusion in the ARF.

RPM Note: Information regarding the establishment of AR Files can be found in "Final Guidance on Administrative Records for Selecting CERCLA Response Actions" OSWER 9833.3A-1, Dec 1990 and in NAVFAC's "CERCLA Interim Administrative Records Management System Users Guide" UG-2024-ENV, Dec 2000. In addition, NAVFAC Atlantic and Pacific, and many FECs have Records Mangers to help RPMs maintain the ARF and Site File.

Contractor and ERP Navy personnel generated ERP documents (commonly referred to as "deliverables") for NAVFAC Mid-Atlantic, Midwest, Southeast and Washington installations will be sent to the designated Regional Data Manager (RDM) for that respective region. The responsible NAVFAC party or a subcontractor acting on behalf of NAVFAC will provide the RDM a paper, electronic and 'native files' copy of each deliverable. Each paper copy will be complete including signed signature page. The electronic copy shall be in Acrobat Adobe Portable Document Format (PDF) and will adhere to the scanning and bookmarking requirements outlined in the Environmental Restoration Recordkeeping Program Manual, Appendix K. All ERP documents associated with the Administrative Record File, Post Decision File and Site File will be prepared and submitted in accordance with the NAVFAC Environmental Restoration Recordkeeping Manual. To view the ER Recordkeeping Program Manual, click on the following URL: https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_nfesc_pp/environmental/erb/resourceerb/rkm_9-1-09.pdf

9.7 Public Affairs

The contractor shall not disclose any data resulting from actions in this contract to the news media, the public, regulatory agencies, or any other non-project-involved personnel. The contractor shall refer all press or public contacts to the RPM. The contractor may not distribute reports or data to any other source, unless specifically authorized, in writing, by the Public Affairs Officer in accordance with NAVFAC Instruction 5720.10A. All project-related materials become permanent property of the United States Government.

9.8 Distribution

Deliverables must be approved by the RPM prior to distribution (see Table 1). [RPM should make below chart specific to your SOW]

Table 1. Schedule of Deliverables

Deliverable	# of Hard Copies/Disks			Due Date
	RPM	Activity/ Installation	Regulatory/ Other	
RI/FS Work Planning Documents				
Project Schedule	1/1	0/0	0/0	2 weeks from

Table 1. Schedule of Deliverables (Continued)

Deliverable	# of Hard Copies/Disks			Due Date
	RPM	Activity/ Installation	Regulatory/ Other	
				award
ESS	1/1	1/1	2/0	30 days from award
Draft RI Work Plan	0/3	0/0	0/0	30 days from award
Gov't comments				1 week
Draft Final RI Work Plan				
All review comments				
Final RI Work Plan	1/1	1/1	0/0	1 week
RI/FS REPORT				
Draft RI/FS Report	1/1	1/1	0/0	180 days from award
Navy Review/comment				200 days from award
Draft-Final RI/FS Report	1/1	1/1	1/1	220 days from award
All Review/Comment				250 days from award
Final RI/FS Report	2/2	1/1	1/1	280 days from award

10.0 SPECIAL CONDITIONS

The contractor will obtain written approval from the appropriate installation personnel [insert location and phone number] prior to obtaining photographic records, still or motion pictures, and aerial or ground photographs; in accordance with Public Law 18 U.S. Code 795 and applicable Station Regulations. The Government may provide a representative to act in an advisory capacity to prevent unauthorized disclosure of classified information.

Any oral directions, instructions, explanations, commitments and/or acceptances given by any government employee to the contractor, shall not be construed by the contractor as a change in scope to this delivery order. Any change in scope of work must be issued to the contractor, in writing, by the Contracting Officer in order to be binding to the government.

The contractor shall provide copies of all project correspondence to the RPM as well as synopses of all phone conversations with regulators in a timely manner. The RPM is to be copied on all electronic correspondence with FEC and Installation/Activity representatives, and others as appropriate and as requested by the RPM.

The contractor shall organize, furnish, maintain, supervise, and direct a work force, which, within the limitations of the provisions of the contract, is thoroughly capable and qualified to effectively perform the work set forth in this delivery order. The contractor will ensure that personnel have been appropriately trained for the tasks and duties assigned. The contractor will maintain and provide upon request, records of training and qualifications of individuals involved in the project.

The contractor and his employees and subcontractors shall become familiar with and obey installation regulations, including fire, traffic, and security regulations. Contractor personnel employed on the installation shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter restricted areas unless required to do so and are cleared for such entry. The contractor's equipment shall be conspicuously marked for identification.

Permit Equivalency for CERCLA On-site Response Actions: CERCLA on-site response actions are exempted by law from requirements to obtain Federal, State or local permits related to any activities conducted completely onsite [CERCLA Section 121(e)]. However, the substantive provisions of the permitting regulations that are applicable or relevant and appropriate, must be met. Expenses to obtain on-site permits that are exempt under CERCLA are not normally reimbursable.

Identification badges and vehicle passes will be furnished without charge; application for and use of passes will be specified by [insert Installation/Activity] Installation Security when issued. Immediately report lost or stolen passes to [insert Installation/Activity] Installation Security and, in writing, to the Contract Specialist (CS) and RPM. Issuance will be coordinated through the RPM.

11.0 REFERENCES

References: (RPM to determine all that are applicable and add site specific references. The RPM should also update the list to include the most recent issuance of any document or instruction)

- **NAVSEA OP-5**, Vol. 1, Seventh Revision, “Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping”.
- **NOSSA Instruction 8020.15(series)**, “Explosives Safety Review, Oversight, And Verification of Munitions Responses ”
- OPNAV INSTRUCTION 8020.15A/MCO 8020.13A, “Explosives Safety Review, Oversight, And Verification of Munitions Responses” (27 Feb 2008)
- OPNAV INSTRUCTION 3500.39 series, Operational Risk Management (ORM) method for identifying hazards
- DOD Explosives Safety Board (DDESB) Standard 6055.09-STD
- DDESB Technical Paper Number 18, dated December 2004
- Marine Corps Order P 8020.10A, “Marine Corps Ammunition Management and Explosives Safety Policy Manual” (for work performed at USMC installations)
- Automated Quality Assessment Planning System (AQAPS)
- Department of the Navy Environmental Restoration Program Manual, August 2006
- Federal Regulation 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER)
- PA/SI report or Archives Search Report of installation
- Installation Master Plan
- IRP Initial Assessment Study/Preliminary Assessment/Site Inspection and other IRP reports related to the site
- Environmental Baseline Survey or Environmental Condition of Property
- Integrated Natural Resources Management Plan
- Military Munitions Rule [Federal Register: February 12, 1997 (Volume 62, Number 29)]
- DOD Policy to Implement the EPA’s Military Munitions Rule (July 1, 1998)

- DOD 4145.26-M, DoD Contractors' Safety Manual for Ammunition and Explosives
- DODD 4715.1E, Environment, Safety, and Occupational Health (ESOH) (March, 2005)
- DOD EDQW Guide for Implementing EPA SW-846 Method 8330B
- Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA Section 120 (h) 42 U.S.C. Section 9620) and as amended by the SARA of 1986
- Community Environmental Response Facilitation Act (CERFA), Public Law 102-426 (Oct 19, 1992)
- The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Part 300, Chapter 40, CFR
- Material Potentially Presenting an Explosive Hazard (MPPEH), DODI 4140.62, November, 2008
- USACOE, Military Munitions Response Actions, EM 1110-1-4009, June, 2007
- USACOE, Military Munitions Center of Expertise, Technical Update for Munitions Constituents (MC) Sampling, March 2005
- USACOE, Conceptual Site Models for Ordnance And Explosives (OE) and Hazardous, Toxic, And Radioactive Waste (HTRW) Projects, Feb 2003
- USACOE, MEC Detection, Recovery, And Disposal Technology Assessment Report, Dec 2005
- USACOE, Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program, USACE Interim Guidance 09-02, July 20, 2009
- US Navy, Conducting Human Health Risk Assessments Under the Environmental Restoration Program (Ser N453E/10595168, 12 Feb. 2001);
- US Navy, Navy Policy for Conducting Ecological Risk Assessments (Ser N453E/9U595355, 05 Apr. 1999)
- US Navy, Navy Human Health Risk Assessment Guidance, December 2008.
- US Navy, Navy guidance for conducting an ecological risk assessment is provided online at http://web.ead.anl.gov/ecorisk/
- USEPA, Handbook on the Management of Munitions Response Actions, (Draft Final May 2005)
- USEPA/DoD/DoI, Munitions and Explosives of Concern Hazardous Assessment (MEC HA) Methodology , February 2010 EPA 505B08001
- USEPA, SW 846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 8330B Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography and Method 8321A Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection
- USEPA, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540/R-D0/002, OSWER 9355.0-75
- USEPA, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final (October 1988) EPA 540/G-89/004, OSWER 9355.3-01
- USEPA, Getting Ready: Scoping the RI/FS (November 1989) OSWER 9355.3-01FS1, NTIS: PB90-274390INX
- USEPA, The Feasibility Study, Development and Screening of Remedial Action Alternatives (November 1989) OSWER 9355.3-01FS3, NTIS: PB90-274416INX

- USEPA, The Feasibility Study: Detailed Analysis of Remedial Action Alternatives (March 1990) OSWER 9355.3-01FS4, NTIS: PB90-272675INX
- USEPA, The Remedial Investigation, Site Characterization and Treatability Studies (November 1989) OSWER 9355.3-01FS2, NTIS: PB90-274408INX
- USEPA, Guidance for Conducting Treatability Studies under CERCLA (October 1992) EPA 540/R-92/071A, NTIS: PB93-126787INX
- USEPA, Superfund Community Involvement Handbook EPA/540/K-01/003, Apr. 2002
- USEPA, Uniform Federal Policy for Quality Assurance Project Plans Manual, March 2005
- NAVFAC Uniform Federal Policy –Sampling and Analysis Plan Template, (See your FEC QA POC for the latest version)
- NAVFAC MEC Uniform Federal Policy –Quality Assurance Project Plan Template, (Available on the Navy MR Portal at www.ert2.org/t2mrportal)
- ESTCP Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response, July 2009

The Navy will provide an installation map of the subject property.

11.0 DEPARTMENT OF THE NAVY POINTS OF CONTACT

Remedial Project Manager (RPM):
Name:
Address:
Phone:
Fax:
Email:

Contract Specialist (CS):
Name:
Address:
Phone:
Fax:
Email:

Activity/Installation Point of Contact (POC):
Name:
Address:
Phone:
Fax:
Email:

12.0 PERSONNEL QUALIFICATIONS

The contractor shall provide UXO technicians having appropriate levels of UXO expertise to perform the work under this task order. The minimum qualifications for UXO-qualified personnel are listed below (*from the DDESB TP-18 Table 4.1).*

DDESB TP-18 Table 4.1. Minimum Qualification Standards

Position Description	Training Required (Notes 1, 2, & 3)	Minimum Years of EOD/UXO Experience (Note 4)	Special Requirements (Note 5)
Senior UXO Supervisor	1, 2, or 3	10 years	Significant experience in all aspects of munitions response actions or range clearance activities, as appropriate for the contracted operation. Five years experience in supervisory positions.
UXO Safety Officer	1, 2, or 3	8 years	Experience in all phases of munitions response actions or range clearance activities, as appropriate for the contracted operation, and applicable safety standards.
UXO Quality Control Specialist	1, 2,3	8 years	Experience in all phases of munitions response actions or range clearance activities, as appropriate for the contracted operation, and the transportation, handling and storage of munitions and commercial explosives.
UXO Technician III	1, 2 or 3	8 years	Prior military EOD and/or commercial UXO experience in munitions response actions or range clearance activities, as appropriate for the contracted operation.
UXO Technician II	1 or 2 ------or------ 3	N/A -------or------ 3 years	Prior military EOD experience ----------or---------- Experience in response munitions response actions or range clearance activities, as appropriate for the contracted operation, plus specific project/explosives safety training.
UXO Technician I	3	0	Successfully completed formal course of instruction appropriate to this skill level.
UXO-Sweep Personnel	Equipment and site specific training	N/A	Safety equipment and site specific training. (Experience at this position is not required for UXO Technician I certification.)

Notes:

1. Graduate of a military EOD School of the United States.
2. Graduate of a military EOD school of Canada, Great Britain, Germany, or Australia.
3. Graduate of a formal training course of instruction (see chapter 3 for detailed requirements) or EOD assistant courses.
4. Personnel working in the commercial industry may have significant breaks between jobs. Only actual time performing UXO-related tasks should be counted. (2080 hours = 1 man-year)
5. Divers conducting underwater detection and identification of munitions must have completed both the basic and the underwater portions of NAVSCOLEOD (or foreign equivalent) training.

Sampling for Munitions Constituents (MC)

RPM Note: The section title above is hyperlinked back to the page where each of the four different Field Work template links are located.

MCs are mixtures of explosive compounds and soils in concentrations less than 10% (by weight) for secondary explosives and less than 2% for primary explosives. If you are doing MC sampling in addition to other investigations, please incorporate MC sampling information outlined in this section into your SOW.

4.1 RI Work Plan

The contractor shall prepare and submit a Draft, Draft Final and Final RI Work Plan, with the required appendices, which describe how to implement the requirements and information developed during the planning and scoping of this RI Work Plan. The RI Work Plan will define project objectives, decision making criteria, and associated data needs to reach project closeout and describe Data Quality Objectives (DQOs). The basic RI Work Plan will describe the general methodology for performing the site MC work, including at a minimum:

- Site preparation, including vegetation removal and removal of surface metallic debris (if required)
- Anomaly avoidance measures to be implemented
- Munitions Constituents (MC) Sampling
- Geographical Information Systems (GIS) and data management
- Investigation Derived Waste Management

4.1.1 Site Health & Safety Plan (HASP)

The contractor will prepare and submit a Site Health & Safety Plan (HASP). The HASP will contain an Activity Hazard Analysis (AHA) for each site-specific task to be conducted. The HASP will be appended to the Accident Prevention Plan (APP) that was prepared for the basic contract.

4.1.2 Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP)

The contractor will prepare a Draft and Final SAP/QAPP in accordance with the Guidance for Quality Assurance Project Plans,, the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), the "Uniform Federal Policy for Implementing Environmental Quality Systems" and the " Department of Defense Instruction: Environmental Quality Systems" The SAP will comprise a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP), at a minimum. The FSAP will be submitted as an Appendix to the Removal Work Plan.

The contractor shall propose a methodology for selecting sampling locations, in coordination with the RPM and the stakeholders to characterize and evaluate exposures to MC at the site(s). Samples may be collected using anomaly avoidance techniques to ensure that intrusive sampling of surface and subsurface soils does not result in exposure to explosive safety hazards or upon completion of MEC removal activities, as appropriate to support the RI objectives. Samples shall be analyzed in accordance with the most current approved methods consistent with the QAPP.

RPM Note: The following references for MC Sampling may be useful to the RPM.

a. Munitions Constituent (MC) Sampling Technical Update, USACE Military Munitions Center of Expertise, March 2005

b. Sampling Studies at an Air Force Live-Fire Bombing Range Impact Area, USACE ERDC, February 2006

c. Estimating Energetic Residue Loading on Military Artillery Ranges, Large Decision Units, USACE ERDC, March 2005

d. Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents,USACE ERDC, July 2007

e. USEPA SW 846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 8330B Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography and Method 8321A Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

f. DoD EDQW Guide for Implementing EPA SW-846 Method 8330B

g. Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program, USACE Interim Guidance 09-02, July 20, 2009.

The analytical laboratory should be identified in the proposal and must be identified in the FSAP and hold all applicable state certifications to perform the analytical methods required. Laboratories must also meet Navy IR QA Program requirements presented in the most current version of the Navy Installation Chemical Data Quality Manual, SP-02056-ENV.

The contractor shall determine the position of all sample locations using Global Positioning System (GPS) or other location method that will achieve a horizontal accuracy of [insert number] feet. The contractor shall prepare a drawing and spreadsheet of the sample location information (name, coordinates) and submit it as part of the MC Data Package with the RI Report. The same information will also be submitted to NIRIS using the NEDD and automated data checker. . QA/QC samples of sufficient matrix medium type and quantity must be collected.

The QAPP will outline the contractor's Quality Control and Quality Assurance measures. The duplicate QA and QC samples will be analyzed for the same parameters as the field samples. All samples will be submitted to a Navy-accredited laboratory. All procedures for samples collected and analyzed for MC shall be addressed and identified in the QAPP and FSAP.

RPM Note: If you plan on installing monitoring wells in a MRS, you will need to incorporate anomaly avoidance measures. This is typically done by using a detector to find an area clear of anomalies, pushing the drill to the depth of the detection limits, pulling out the drill and placing the detector in to ensure the next depth is clear. This can be cumbersome, so consider installing wells in areas that have no MEC history if possible. Sometimes moving the location of the well can avoid potential MEC, without sacrificing the objectives of the well location and sampling.

The USACE has a reference that can be useful for MC sampling titled USACOE MM CX Technical Update for Munitions Constituents Sampling dated March, 2005. In addition, the

EPA's SW 846 Method 8330B (November 2006 update to the original 8330) includes field sampling techniques as well as analytical procedures for munitions constituents sampling on ranges. EPA Method 8321 uses a mass spectrometer to positively identify the compounds present.

RPMs will need to choose which method to use based on site-specific DQOs. It should be noted that because EPA Method 8330B is relatively new, only a few commercial laboratories have been approved by the Navy to perform this analytical method. If method 8330B is chosen it is important to review the DoD Environmental Data Quality Workgroup Guide for Implementing EPA SW-846 Method 8330B. Important considerations include involving a risk assessor, and processing the entire field sample through the machine grinding process to reduce error. RPMs should be aware that the grinding and subsequent extraction procedure may overestimate the risk posed by the constituents by altering the sample's matrix conditions. Method 8330B uses a UV detector, which is not definitive, so a confirmatory method (lc/ms is an option in 8330B or 8321) could also be used on a subset of the samples to positively identify the constituents present. The RPM will have to determine how to cost effectively manage the sampling and analysis costs. Also, the MR portal has a summary on Energetic Constituent Sampling.

For Munitions Constituents below an explosive hazard, the RPM is required to develop a UFP-SAP. The UFP QAPP Manual Guidance is implemented by NAVFAC through completion of thirty seven separate worksheets that address specific elements of the UFP QAPP guidance. Each of the worksheets references the applicable section of the UFP QAPP Manual it is intended to address. The Navy UFP-SAP template for each of these worksheets is included as a reference. The Navy UFP-SAP team has developed "Greentext" for the required UFP-SAP which provides suggestions and examples on how to populate the UFP-SAP worksheets for a MC sampling project. These worksheets are NAVFAC specific and provide a graded approach to developing the sampling and analysis plan.

4.1.3 Other Relevant Planning Documents

The contractor shall prepare the following additional planning documents, based on knowledge of site conditions provided by the PA/SI and the site-specific RI requirements:

- [insert applicable documents (e.g., Environmental Protection Plan, Erosion Control, Stormwater Management Plan, etc.]

5.0 *RI FIELD ACTIVITIES*

5.1 Site Preparation

The contractor shall perform necessary site preparation to adequately support the field sampling methodology outlined in this SOW. [RPM to outline the type and extent of site preparation requirements and/or restrictions based on your site]. Procedures and equipment requirements shall be approved by the RPM prior to execution.

RPM Note: Site preparation for MC sampling will typically be minimal. Site preparation at an MRS generally consists of vegetation clearance and surface removal of debris from the areas that will undergo survey and investigation. It may also include a surface sweep for

MEC to ensure safety. The RPM should consider the type of vegetation that needs to be cleared, the re-growth rate, and the cost impacts of site preparation. Vegetation removal at some sites can be quite costly. If the surface MEC have been removed from the investigation areas, UXO escorts may not be required for the survey teams. NOSSA/MARCORSYSCOM will determine escort requirements as part of the ESS approval process. RPMs should evaluate the need for other site work requiring vegetation clearance (e.g. collection of geophysical data) and schedule these activities concurrently, if possible, to avoid the need for multiple vegetation clearing operations at the same site.

5.2 Munitions Constituents Sampling and Analysis Activities

The contractor shall propose a plan to collect samples and identify the depth of samples, proposed analysis, and measures to ensure the samples are collected safely. For estimating and planning purposes, the contractor should expect to collect a total of [insert number] samples [including quality control (QC) and quality assurance (QA) samples]. The laboratories shall provide analytical results within 30 days of sample receipt. In accordance with Navy IR QA Program requirements presented in the most current version of the Navy Installation Chemical Data Quality Manual, SP-02056-ENV, the contractor shall be responsible for quality control planning and implementation, performing data validation, and for submitting the appropriate NIRIS electronic data deliverable (NEDDs) via the NIRIS automated data checker.

RPM Note: MC sampling is an area that will be critical to have stakeholder acceptance. Typically SI sampling will have been done to determine the site boundaries and explore the nature and extent of MC contamination. Ideally any sampling at this point should be to augment the work begun during the SI, and be focused on filling any data gaps and addressing any additional sampling issues with the stakeholders in order to reach a level of certainty regarding the nature and extent of MC contamination at the site. The RPM will need to add language to reflect whether the sampling activity is to augment SI data or whether it is to collect original data from the site. The RPM should add information and references for any past data collected. If the SI did not conduct any sampling, be sure to focus the RI sampling on both defining the site limits and assessing risks from MC.

The need for MC sampling is based on a site specific determination. Past MEC related uses at the site should be considered in developing the SAP. For example, sampling approaches for OB/OD sites will differ from the approach used to assess areas used as target areas within a firing range. Field sampling and field testing techniques, as opposed to wet chemistry analysis by an off site lab, may be appropriate for some sites.

5.3 Investigation Derived Waste (IDW)

IDW management shall ensure protection of human health and the environment and be in compliance with ARARs. US EPA/state policy shall be incorporated into the IDW Management Plan developed for the RI Workplan.

RPM Note: US EPA's Guide to Management of Investigation-Derived Wastes (OSWER 9345.3-03FS, Jan. 1992) presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.

Geophysical Investigation without Intrusive Investigation

RPM Note: The section title above is hyperlinked back to the page where each of the four different Field Work template links are located.

4.1 RI Work Plan

The contractor shall prepare and submit a Draft, Draft Final and Final RI Work Plan, with the required appendices, which incorporate the data requirements and information developed during the planning and scoping task. The RI Work Plan will define project objectives and associated data needs to reach project closeout and describe Data Quality Objectives. The basic RI Work Plan will describe the general methodology for performing the site MEC work, including at a minimum:

- Site preparation including vegetation removal and removal of surface metallic debris
- Location surveys and mapping
- Geophysical System Verification (instrument verification strip, noise strip, and blind seeding)
- Data Quality Objectives (DQOs)
- Description of anomaly avoidance procedures
- Details of the QC program
- Geographical Information Systems (GIS) and data management

The RI Work plan will include a geophysical investigation plan that describes the equipment, personnel and techniques to be used to collect digital geophysical data at the site. The plan will be detailed and will describe the sensor(s), platform(s), positioning and data analysis methods the contractor will use at each specific removal site(s) to meet the quality assurance and quality control requirements (This could be the accuracies required for an instrument verification strip, blind seeds and for positioning). Consistent with the requirements of the basic contract, the plan will identify, by name, key personnel responsible for data processing and quality control (QC) and will include a description of their experience and qualifications to perform the work assigned.

RPM Note: The RPM will need to review NOSSAINST8020.15 (series) and submit the appropriate paperwork to NOSSA or MARCORSYSCOM to get concurrence that an ESS is not required based on anomaly avoidance procedures.

4.1.1 Site Health & Safety Plan (HASP)

The contractor will prepare and submit a Site Health & Safety Plan (HASP). The HASP will contain an Activity Hazard Analysis (AHA) for each site-specific task to be conducted. The HASP will be appended to the Accident Prevention Plan (APP) that was prepared for the basic contract.

4.1.2 Geophysical System Verification (GSV)

The contractor shall prepare and submit as part of the removal work plan a section on geophysical system verification (GSV) proposed for the site. The contractor will describe the purpose for the GSV (e.g., confirm system performance and ensure that the data quality objectives (DQO) can be met). The contractor shall identify the methods to be used to:

- verify that the geophysical system is performing correctly by measuring the sensor responses of a small number of well-characterized items and confirming that the responses lie within expected parameters (and that the measured locations of the detected items are within requirements) and
- measure the site noise and determine whether targets of interest can be detected reliably to their depth of interest under the site conditions present.
- Emplace throughout the production site Industry Standard Objects (ISOs) in a blind seeding program to confirm production geophysics in the field.

RPM Note: In most instances the complex GPO has been replaced by the GSV. Sites that have a unique requirement for a GPO can reference the* ITRC Technical/Regulatory Guideline for Geophysical Prove-outs for Munitions Response Projects *for details on how to construct and implement a GPO.

The instrument verification test strip concept can be used to verify instrument performance on any site and is an integral part of quality monitoring. For very large sites, it may be cost effective to construct multiple replications of the test strip so that crews can conduct their daily checks without undue transit time. The GSV moves resources from an up-front evaluation of the geophysical systems and their performance to an ongoing verification of the system performance. Utilizing a physics-based approach reduces the logistical burden (e.g., multiple mobilizations, acquisition of surrogates) of the older GPO process, allows use of a smaller plot, and results in greater confidence in the performance of the geophysical project itself. For more information on the GSV, see ESTCP's Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response.

4.1.3 MEC UFP-QAPP

The contractor shall prepare a MEC UFP-QAPP that will address all quality control methods to be used to control MEC activities on the project. The MEC UFP-QAPP will discuss how the contractor intends to implement quality control for all site operations, including QC of equipment and personnel, QC of the data, and the proposed QC personnel and their qualifications. Quality control procedures shall be developed to ensure that quality of geophysical survey data and intrusive sampling for potential MEC anomalies meets the DQO's established by the RI/FS work plan. The MEC UFP-QAPP will be prepared as an Appendix to the RI Work Plan.

RPM Note: See the MEC UFP-QAPP template, the Adak MEC UFP-QAPP example, Adak Technical Management Plan (Work plan), and the Quality Assessment SOW template on the MR Portal for typical PQO's/DQOs, Measurement Performance Criteria, and SOPs. It should be noted that the PQCP in the Adak Technical Management Plan is abbreviated and refers to the Adak MEC UFP-QAPP for supporting details. RPMs are encouraged to use the UFP-QAPP format for their project sites.

The RPM needs to review the QAPP for several factors. The contractor should at a minimum include daily function tests of the equipment and personnel to ensure proper operation and minimal variances in performance. Refer to Military Munitions Response Actions; USACE Engineer Manual (EM) 1110-1-4009; June 2007, which is a reference which outlines daily and project function checks to be performed and documented by the contractor. The QAPP should also identify that the contractor will repeat collection of data in some percentage of repeated lanes or sections to ensure data repeatability and location repeatability. To ensure

there is minimal variation in the data, the data collection team will collect data in an area, with some time separation between the collections of the two data sets. This is often referred to as repeatability. These requirements should be outlined in the QAPP. The RPM should also ensure that there is proper documentation of the QC measures taken at the site.

RPM Note on Government quality assurance requirements: RPMs should be aware that NOSSAINST 8020.15(series) requires that each munitions response project have a QC program administered by the UXO contractor and a QA program administered by an independent, third-party activity. The complexity of the QC and QA programs is dependent on the nature of the project. The Naval Explosive Ordnance Technology Division (NAVEODTECHDIV) has experience, expertise and technically trained personnel in conducting quality assessments and developing the quality assessment reports for munitions response projects. The contact names are listed with the MRP Workgroup. Another alternative is to use a third party contract not associated with the site to perform quality assessment field activities for the Government. Typical aspects of quality assurance may include blind seeding of MEC-like items in the survey area, performing a partial survey on grids cleared by the contractor to confirm the findings, and reviewing documents to ensure consistency between work plans and field applications. The ultimate quality assurance requirements should be determined and budgeted by the RPM. See the Quality Assessment SOW template on the MR Portal for more information.

When developing QC and QA plans it is important to keep in mind that the objective of these plans and their execution is to ensure that agreed on standards of performance for work conducted on the project have been met. The approaches used for verifying this should be consistent with the approach used to conduct the work to avoid setting inconsistent standards for production, QC, and QA (e.g. similar MEC detection systems should be used for production, QC, and QA phases of the project). In addition, QC and QA processes are best scheduled in parallel with production phases of project work and not after completion of productions work. This will allow corrections to be made in production processes, if necessary, and avoid the need for rework of major portions of work that were completed prior to QC or QA review.

4.1.4 Other Relevant Planning Documents

The contractor shall prepare the following additional planning documents, based on knowledge of site conditions provided by the PA/SI and the site-specific RI requirements:

- [insert applicable documents (e.g., Erosion Control, Stormwater Management Plan, etc.]

5.0 RI FIELD ACTIVITIES

5.1 Site Preparation

The contractor shall perform necessary site preparation to adequately support the field sampling methodology outlined in this SOW. [RPM to outline the type and extent of site preparation requirements and/or restrictions]. Procedures and equipment requirements shall be approved by the RPM prior to execution.

RPM Note: Site preparation at an MRS generally consists of brush clearance and surface removal of debris from the areas that will undergo survey and investigation. It may also

include a surface sweep for MEC to ensure the safety of the geophysical teams. The RPM should consider the type of growth to be cleared, the re-growth rate, and the cost impacts of site preparation. Brush removal at some sites can be quite costly and may result in ecological damage. If the surface MEC have been removed from the investigation areas, no UXO escorts should be required for the survey teams. If the surface has not been cleared the RPM should work with NOSSA/MARCORSYSCOM to determine if UXO escorts for the investigation team will be required.

5.2 Location Surveys and Mapping

The contractor shall perform location recording and mapping using techniques that allow easy conversion/submission of data in the required format e.g., state plane coordinates. The contractor may use established control monuments, however, should the contractor select to set any property boundaries or monuments, this work shall be performed by a Professional Land Surveyor licensed in the [insert State]. Existing monument locations will be provided to the contractor. Contractor personnel who are knowledgeable and competent in land surveying and use of surveying equipment may perform grid and/or transect location and layout. The contractor shall prepare all location data and submit following completion of the work. Data must be provided using the appropriate Naval Installation Restoration Information Solution (NIRIS) Electronic Data Deliverable (NEDD) via the web based data checker in accordance with the NEDD SOP. Survey data shall include, at a minimum, a drawing and spreadsheets of survey information. For each site, the drawing shall cover the entire site and will include the list of coordinates for corners, starting, ending, turning locations, reference monuments used in survey, and other pertinent features of grids or transects, to include but not limited to MEC location data including grid number where found, item number assigned, type of item, location coordinates to nearest foot, and depth below ground surface.

5.3 Digital Geophysical Mapping

The contractor shall propose a methodology and rationale for performing digital geophysical mapping (DGM) to support the data requirements of the RI/FS. The contractor may propose to map grids or transects, or a combination of these. The contractor shall produce maps of the site that show the major geophysical features. The contractor shall update and manage the project GIS in NIRIS, or if needed, an export of the NIRIS data using a local machine running ArcGIS or ArcInfo. Any project related spatial data including maps, models and associated collected or created data must then be submitted back to NIRIS according to the NIRIS Non-NEDD Deliverable Submittal Guidelines SOP. This would include daily geophysical data, ordnance related items found during the investigation, positively identified MEC, positively identified archeological sites, environmental sample locations, inaccessible areas such as brush piles, fence lines, areas of bare rock, etc. See Section 8.3 for details.

If mag & flag techniques are proposed, the location of [all, MEC/MPPEH only, MEC/MPPEH and significant] anomalies must be electronically recorded and entered into the project GIS along with the anomaly information (e.g., identification, depth, disposition, etc.).

RPM Note: The RPM with the stakeholders should define what level of geophysical mapping and investigation is adequate to characterize the site. The RPM will need to consider whether the goal of the survey is to locate broad target or disposal areas, or specific individual anomalies that could represent MEC. This will focus the goals of the geophysical survey. Surveys are typically conducted using grids of 100ftx100ft, but could also utilize transects or other patterns based site specific information. Wide area assessment technologies may be appropriate for consideration at large sites that have little

documentation concerning the location of range related activities. Stakeholder buy-in is critical and leads to greater certainty in the decision making process about the site, cleanup options, and future land use. Obviously, the more area mapped, the better the characterization, but also increased costs. So the RPM should work with stakeholders to find the acceptable level of work that will adequately characterize the site within the budget. The costs of a survey are minimal compared to the costs of the intrusive anomaly investigation so consider these factors when scoping your work. In the Management Guidance Principles document, DoD and EPA agree to a preference for using investigative techniques that provide an auditable, objective record of investigation area and results. This usually means EM and DGPS or something similar as opposed to mag & flag.

RPMs should be aware that there are circumstances where analog metal detection procedures (called mag & flag or mag & dig) may be more appropriate (e.g., OB/OD areas, areas adjacent to targets, etc.). Mag, Flag, & Dig operations are most useful when there is known dispersed contamination of MEC and metal debris where a digital geophysical map would not provide the best level of information. This is sometimes done to clear the surface and to locate major areas of MEC contamination within a site. It must be understood that Mag, Flag, & Dig operations do not produce a digital record of the position of the instrument, operator, or the instrument signal associated with the area surveyed by the MEC technician and are intrusive. Consequently, care must be taken to ensure that adequate QC/QA measures are taken to ensure that AOC's are adequately evaluated and that the performance requirements of the process for removal of MEC and debris metal have been met and the explosives safety requirements of the NOSSA/MARCORSYSCOM approved ESS are also met. An RPM should consider Mag, Flag, & Dig for their site if it is less important to record the position of each anomaly, but only record the significant MEC finds. If Mag, Flag, & Dig operations are chosen as an investigative (or remediation) technique, A QAPP must be developed to ensure that an objective record is maintained of the areas where these techniques have been used.

Geophysical Investigation with Intrusive Investigation

RPM Note: The section title above is hyperlinked back to the page where each of the four different Field Work template links are located.

4.1 RI Work Plan

The contractor shall prepare and submit a Draft, Draft Final and Final RI Work Plan, with the required appendices, which incorporate the data requirements and information developed during the planning and scoping task. The RI Work Plan will define project objectives and associated data needs to reach project closeout and describe Data Quality Objectives. The basic RI Work Plan will describe the general methodology for performing the site MEC work, including:

- Site preparation including vegetation removal and removal of surface metallic debris
- Location surveys and mapping
- Geophysical System Verification (instrument verification strip, noise strip, and blind seeding)
- Data Quality Objectives (DQOs)
- Description of anomaly selection procedures
- Description of anomaly removal procedures
- Details of the QC program
- Description of MEC & MPPEH management
- Geographical Information Systems (GIS) and data management

The RI Work plan will include a geophysical investigation plan that describes the equipment, personnel and techniques to be used to collect digital geophysical data at the site. The plan will be detailed and will describe the sensor(s), platform(s), positioning and data analysis methods the contractor will use at each specific removal site(s) to meet the quality assurance and quality control requirements (This could be the accuracies required for an instrument verification strip, blind seeds and for positioning). Consistent with the requirements of the basic contract, the plan will identify, by name, key personnel responsible for data processing and quality control (QC) and will include a description of their experience and qualifications to perform the work assigned.

RPM Note: The RPM will need to submit an ESS to NOSSA or MARCORSYSCOM for endorsement to the DDESB for their approval prior to field work beginning. The ESS shall be completed in accordance with NOSSAINST 8020.15(series), Enclosure (3) "Guidelines for Preparing an Explosives Safety Submission."

4.1.1 Site Health & Safety Plan (HASP)

The contractor will prepare and submit a Site Health & Safety Plan (HASP). The HASP will contain an Activity Hazard Analysis (AHA) for each site-specific task to be conducted. The HASP will be appended to the Accident Prevention Plan (APP) that was prepared for the basic contract.

4.1.2 Geophysical System Verification (GSV)

The contractor shall prepare and submit as part of the removal work plan a section on geophysical system verification (GSV) proposed for the site. The contractor will describe the purpose for the

GSV (e.g., confirm system performance and ensure that the data quality objectives (DQO) can be met). The contractor shall identify the methods to be used to:

- verify that the geophysical system is performing correctly by measuring the sensor responses of a small number of well-characterized items and confirming that the responses lie within expected parameters (and that the measured locations of the detected items are within requirements) and
- measure the site noise and determine whether targets of interest can be detected reliably to their depth of interest under the site conditions present.
- Emplace throughout the production site Industry Standard Objects (ISOs) in a blind seeding program to confirm production geophysics in the field.

RPM Note: In most instances the complex GPO has been replaced by the GSV. Sites that have a unique requirement for a GPO can reference the* ITRC Technical/Regulatory Guideline for Geophysical Prove-outs for Munitions Response Projects *for details on how to construct and implement a GPO.

***The instrument verification test strip concept can be used to verify instrument performance on any site and is an integral part of quality monitoring. For very large sites, it may be cost effective to construct multiple replications of the test strip so that crews can conduct their daily checks without undue transit time. The GSV moves resources from an up-front evaluation of the geophysical systems and their performance to an ongoing verification of the system performance. Utilizing a physics-based approach reduces the logistical burden (e.g., multiple mobilizations, acquisition of surrogates) of the older GPO process, allows use of a smaller plot, and results in greater confidence in the performance of the geophysical project itself. For more information on the GSV, see ESTCP's* Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response.**

4.1.3 MEC UFP-QAPP

The contractor shall prepare a MEC UFP-QAPP that will address all quality control methods to be used to control MEC activities on the project. The MEC UFP-QAPP will discuss how the contractor intends to implement quality control for all site operations, including QC of equipment and personnel, QC of the data, and the proposed QC personnel and their qualifications. Quality control procedures shall be developed to ensure that quality of geophysical survey data and intrusive sampling for potential MEC anomalies meets the DQO's established by the RI/FS work plan. The MEC UFP-QAPP will be prepared as an Appendix to the RI Work Plan.

RPM Note: See the MEC UFP-QAPP template, the Adak MEC UFP-QAPP example, Adak Technical Management Plan (Work plan), and the Quality Assessment SOW template on the MR Portal for typical PQO's/DQOs, Measurement Performance Criteria, and SOPs. It should be noted that the PQCP in the Adak Technical Management Plan is abbreviated and refers to the Adak MEC UFP-QAPP for supporting details. RPMs are encouraged to use the UFP-QAPP format for their project sites.

The RPM needs to review the QAPP for several factors. The contractor should at a minimum include daily function tests of the equipment and personnel to ensure proper operation and minimal variances in performance. Refer to Military Munitions Response Actions; USACE Engineer Manual (EM) 1110-1-4009; June 2007, which is a reference which outlines daily and project function checks to be performed and documented by the contractor. The QAPP should also identify that the contractor will repeat collection of data in some percentage of repeated lanes or sections to ensure data repeatability and location repeatability. To ensure

there is minimal variation in the data, the data collection team will collect data in an area, with some time separation between the collections of the two data sets. This is often referred to as repeatability. These requirements should be outlined in the QAPP. The RPM should also ensure that there is proper documentation of the QC measures taken at the site.

RPM Note on Government quality assurance requirements: RPMs should be aware that NOSSAINST 8020.15(series) requires that each munitions response project have a QC program administered by the UXO contractor and a QA program administered by an independent, third-party activity. The complexity of the QC and QA programs is dependent on the nature of the project. The Naval Explosive Ordnance Technology Division (NAVEODTECHDIV) has experience, expertise and technically trained personnel in conducting quality assessments and developing the quality assessment reports for munitions response projects. The contact names are listed with the MRP Workgroup. Another alternative is to use a third party contract not associated with the site to perform quality assessment field activities for the Government. Typical aspects of quality assurance may include blind seeding of MEC-like items in the survey area, performing a partial survey on grids cleared by the contractor to confirm the findings, and reviewing documents to ensure consistency between work plans and field applications. The ultimate quality assurance requirements should be determined and budgeted by the RPM. See the Quality Assessment SOW template on the MR Portal for more information.

When developing QC and QA plans it is important to keep in mind that the objective of these plans and their execution is to ensure that agreed on standards of performance for work conducted on the project have been met. The approaches used for verifying this should be consistent with the approach used to conduct the work to avoid setting inconsistent standards for production, QC, and QA (e.g. similar MEC detection systems should be used for production, QC, and QA phases of the project). In addition, QC and QA processes are best scheduled in parallel with production phases of project work and not after completion of productions work. This will allow corrections to be made in production processes, if necessary, and avoid the need for rework of major portions of work that were completed prior to QC or QA review.

4.1.4 Explosives Safety Submission (ESS)

The contractor (or RPM) will prepare and submit an Explosives Safety Submission (ESS) in accordance with NOSSA Instruction 8020.15(series), Enclosure (3). It is to be coordinated with the installation Explosives Safety Officer and Public Works Planning Department and then submitted to NOSSA/MARCORSYSCOM for their endorsement to the DDESB for their approval prior to the start of fieldwork. The approved ESS [will/will not] be included as an Appendix to the RI Work Plan and the two documents must be consistent. The ESS is the primary explosives safety document at the site.

RPM Note: The RPM will need to submit an ESS to NOSSA or MARCORSYSCOM for approval prior to field work beginning. The ESS shall be completed in accordance with NOSSAINST 8020.15(series), Enclosure (3) "Guidelines for Preparing an Explosives Safety Submission." NOSSA may take up to a month to review and comment on each draft and the final ESS. The RPM should also plan on the DDESB review taking at least one month for their review and approval.

4.1.5 Other Relevant Planning Documents

The contractor shall prepare the following additional planning documents, based on knowledge of site conditions provided by the PA/SI and the site-specific RI requirements:

- [insert applicable documents (e.g., Erosion Control, Stormwater Management Plan, etc.]

5.0 RI FIELD ACTIVITIES

5.1 Site Preparation

The contractor shall perform necessary site preparation to adequately support the field sampling methodology outlined in this SOW. [RPM to outline the type and extent of site preparation requirements and/or restrictions]. Procedures and equipment requirements shall be approved by the RPM prior to execution.

RPM Note: Site preparation at an MRS generally consists of brush clearance and surface removal of debris from the areas that will undergo survey and investigation. It may also include a surface sweep for MEC to ensure the safety of the geophysical teams. The RPM should consider the type of growth to be cleared, the regrowth rate, and the cost impacts of site preparation. Brush removal at some sites can be quite costly and may result in ecological damage. If the surface MEC have been removed from the investigation areas, no UXO escorts should be required for the survey teams. If the surface has not been cleared the RPM should work with NOSSA/MARCORSYSCOM to determine if UXO escorts for the investigation team will be required.

5.2 Location Surveys and Mapping

The contractor shall perform location recording and mapping using techniques that allow easy conversion/submission of data in the required format e.g., state plane coordinates. The contractor may use established control monuments, however, should the contractor select to set any property boundaries or monuments, this work shall be performed by a Professional Land Surveyor licensed in the [insert State]. Existing monument locations will be provided to the contractor. Contractor personnel who are knowledgeable and competent in land surveying and use of surveying equipment may perform grid and/or transect location and layout. The contractor shall prepare all location data and submit following completion of the work. Data must be provided using the appropriate Naval Installation Restoration Information Solution (NIRIS) Electronic Data Deliverable (NEDD) via the web based data checker in accordance with the NEDD SOP. Survey data shall include, at a minimum, a drawing and spreadsheets of survey information. For each site, the drawing shall cover the entire site and will include the list of coordinates for corners, starting, ending, turning locations, reference monuments used in survey, and other pertinent features of grids or transects, to include but not limited to MEC location data including grid number where found, item number assigned, type of item, location coordinates to nearest foot, and depth below ground surface.

5.3 Digital Geophysical Mapping

The contractor shall propose a methodology and rationale for performing digital geophysical mapping (DGM) to support the data requirements of the RI/FS. The contractor may propose to map grids or transects, or a combination of these. The contractor shall update and manage the project GIS in NIRIS, or if needed, an export of the NIRIS data using a local machine running ArcGIS or ArcInfo. Any project related spatial data including maps, models and associated collected or created data must then be submitted back to NIRIS according to the NIRIS Non-NEDD Deliverable

Submittal Guidelines SOP. This would include daily geophysical data, MEC related items found during the investigation, positively identified MEC, positively identified archeological sites, environmental sample locations, inaccessible areas such as brush piles, fence lines, areas of bare rock, etc. See Section 8.3 of the SOW for details.

RPM Note: The RPM with the stakeholders should define what level of geophysical mapping and investigation is adequate to characterize the site. The RPM will need to consider whether the goal of the survey is to locate broad target or disposal areas, or specific individual anomalies that could represent MEC. This will focus the goals of the geophysical survey. Surveys are typically conducted using grids of 100ftx100ft, but could also utilize transects or other patterns based site specific information. Wide area assessment technologies may be appropriate for consideration at large sites that have little documentation concerning the location of range related activities. Stakeholder buy-in is critical and leads to greater certainty in the decision making process about the site, cleanup options, and future land use. Obviously, the more area mapped, the better the characterization, but also increased costs. So the RPM should work with stakeholders to find the acceptable level of work that will adequately characterize the site within the budget. The costs of a survey are minimal compared to the costs of the intrusive anomaly investigation so consider these factors when scoping your work. In the Management Guidance Principles document, DoD and EPA agreed to a preference for using investigative techniques that provide an auditable, objective record of investigation area and results. This usually means EM and DGPS or something similar as opposed to mag & flag.

RPMs should be aware that there are circumstances where analog metal detection procedures (called mag & flag or mag & dig) may be more appropriate (e.g., OB/OD areas, areas adjacent to targets, etc.). Mag, Flag, & Dig operations are most useful when there is known dispersed contamination of MEC and metal debris where a digital geophysical map would not provide the best level of information. This is sometimes done to clear the surface and to locate major areas of MEC contamination within a site. It must be understood that Mag, Flag, & Dig operations do not produce a digital record of the position of the instrument, operator, or the instrument signal associated with the area surveyed by the MEC technician. Consequently, care must be taken to ensure that adequate QC/QA measures are taken to ensure that AOC's are adequately evaluated and that the performance requirements of the process for removal of MEC and debris metal have been met. An RPM should consider Mag, Flag, & Dig for their site if it is less important to record the position of each anomaly, but only record the significant MEC finds. If Mag, Flag, & Dig operations are chosen as an investigative (or remediation) technique, A QAPP must be developed to ensure that an objective record is maintained of the areas where these techniques have been use.

5.4 Intrusive Investigations

The contractor shall implement MEC [clearance / sampling] in accordance with DOD and DON requirements and the approved RI Work Plan. The contractor will describe in their proposal the method to be used for reacquiring target anomalies from the geophysical data and for performing the investigation and clearance of each target site. For estimating and planning purposes, the contractor is to assume [Insert number of anomalies anticipated in a grid, acre, or transect, based on what is being used at your site]. The contractor shall identify in the RI Work Plan the decision criteria for halting or expanding the excavation of anomalies in an area. The contractor will outline the details of the investigation in the ESS for approval by NOSSA/MARCORSYSCOM and ensure

that all work descriptions in the RI Work Plan are consistent with the NOSSA/MARCORSYSCOM approved ESS.

RPM Note: It is critical that the anomaly selection process be coordinated with your stakeholders as this will be a key factor in the remedial decision process. The anomaly selection process involves assessing the known data from the GSV and using geophysical data software, such as Oasis Montaj or Uhunter, in order to identify the characteristics of an MEC anomaly for your specific site conditions. The DGM survey will see all metal objects, so the key is to focus the investigation on the anomaly signatures that are most indicative of MEC. The process can often be iterative where the anomaly selection process is conservative at first and then adjusted based on the field data being collected. The smaller and deeper munitions will result in less defined signals because of their size/depth and this can lead to an increased cost of investigation. An iterative process with stakeholders is a good way to minimize costs and get buy in to the process of which anomalies to investigate.

At a typical MRP site, along a segment of transect or within a grid, the MEC team will relocate and investigate the anomalies selected for investigation from the DGM data. On sites where there is so much metal as to make selecting discreet anomalies from the DGM data impossible, alternate language may be needed so that the contractor can propose trenching or other methods as a means of quantifying and characterizing the amount of MEC and/or MPPEH at the site. They should still propose to perform DGM and then use that data to select areas for investigation. If you are doing sampling at a site, it is important to build in a method where you can investigate areas around MEC findings so that you can characterize the site while you are in the field.

The ESS may contain language such as this: "The UXO Technician will carefully remove enough soil, without disturbing the MEC, to facilitate positive identification or to obtain its identification features. UXO Technicians will make every effort to identify MEC through visual examination of the item for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the fuze conditions can be ascertained. If the condition is questionable, consider the fuze to be armed. The fuze is considered the most hazardous component of a UXO, regardless of type or condition. The SUXOS make final determination of identification of the item and the disposition of the item prior to implementing any disposal operations. MEC and MPPEH will not be moved by personnel unless it is safe to do so. Movement of MEC and MPPEH by hand is authorized only after positive identification and a determination by the UXO Technician III and either the SUXOS or UXOSO and the MEC is safe to move."

5.5 MEC Management

The contractor shall manage all MEC, MPPEH, and related debris in accordance with DOD and DON requirements and the approved RI/FS Work Plan. The contractor shall describe their proposed methodology for accounting for all MEC and MPPEH items or components encountered from field discovery to point of disposal. This accounting shall include the amounts of MEC and/or MPPEH, identification and condition, location, orientation and depth of MEC, storage and disposition. The accounting system shall also account for all demolition materials utilized to detonate MEC and or MPPEH on site. This accounting process shall be outlined in the RI/FS Work Plan and included in an appendix to the RI/FS Report. The contractor shall take digital photographs of identifiable MEC found during the investigation, which shall be attached to the MEC locations displayed in the GIS.

RPM Note: Some project teams may also require that all MEC and MPPEH be photographed.

5.5.1 MEC Treatment

RPM Note: The RPM needs to understand that RI Field Activities that recovered MEC will require on- or off-site treatment of MEC during the investigation phase before the final remedy is selected. This is due to the fact that known MEC that is discovered during the investigation will not be reburied or left in place due to its hazard.

The contractor shall be responsible for the destruction of all MEC in accordance with DOD and DON requirements as described in the approved ESS and RI/FS Work Plan. For planning and estimating purposes, the contractor shall be prepared to dispose of [insert number] items of MEC ranging in size from [insert size of MEC expected at your site]. The contractor shall describe in their proposal the methods, personnel, and equipment they will use to perform disposal of MEC on the site.

RPM Note: The RPM needs to be aware of the process required for any treatment/disposal by detonation of MEC. The RPM should first understand the viable options, which include 1) on-site open detonation, 2) detonation in a contained detonation chamber (CDC), and 3) transport to an approved facility for detonation. The decision to treat **in situ** ***or move the MEC item can only be made by the Senior UXO Supervisor or a UXO Technician III team leader. If the MEC item is a UXO, then only active duty EOD personnel can certify them as safe to transport. On Navy sites, the Navy EOD may manage the disposal of MEC items but this is for emergency situations for unexpected findings versus a cleanup project. On munitions response projectt sites the contractor performing MEC remedial investigation/action has that responsibility. The RPM will need to decide how this will be handled for your specific site and make sure the requirement is clear in the SOW. This is another case where the stakeholders should be involved in the decision because in many instances, they will strongly object to open detonation as the preferred method of destruction and may request that MEC be destroyed in a CDC. If you have a case where MEC is determined not safe to move, you will need to plan for on-site Blow in Place (BIP) detonation. This contingency should always be built into your RI Work Plan, even if it is unlikely.***

Open detonation is cheaper and is the primary practice of military EOD units, though you may need to sample and clean the area after detonation. There are also noise and public notification issues to consider. You may also need to coordinate with your local air board and comply with some substantive requirements. Recall that under CERCLA, we do not have to get permits, but need to meet the substantive permitting requirements of permits or regulations. There are many studies that show that a well-designed detonation does not leave detectable residual chemicals.

The CDC is a commercial unit that has heavy walls to contain to explosive force and it has air treatment units connected to take out particulate. The CDC T-10 is limited to a Net Explosive Weight of 13 pounds of explosives. This limits the size of item that can be detonated. The T-30 is being tested and has the ability to contain 40lbs of explosives. The other limitations of the CDC is that it is quite costly and often unavailable based on use at other sites. It is a favorite of regulators because it is contained. While DDESB has approved use of the CDC unit, you still need to get an ESS approved through NOSSA/MARCORSYSCOM and then DDESB for your site prior to its use. The CDC is too

expensive to remain on site for the duration of the project and typically will be mobilized at the end of the project for just the number of days needed to complete disposal of the MEC. During the collection period and until the CDC can be mobilized, any munitions recovered will have to be stored in a NOSSA/MARCORSYSCOM approved, secured storage area. An empty, site approved magazine in an ammunition facility is an excellent resource when it is available. If not, the contractor will have to site, install, maintain and remove a temporary storage facility that may have more than one magazine due to ammunition compatibility storage requirements. All of these issues should be discussed with the stakeholders with the goal of reaching a sensible solution. Whatever the decision, the information about managing MEC and treatment/disposal operations will have to be included in the ESS.

5.5.2 Material Potentially Presenting an Explosives Hazard (MPPEH) Management

The contractor shall be responsible for the disposition of all MPPEH in accordance with the approved ESS and RI Work Plan. The contractor shall identify in his proposal the methods and equipment to be used to, inspect, certify, verify, demilitarize, and dispose of MPPEH from the site. The contractor shall identify the qualifications of personnel who will be involved in inspecting, certifying and verifying the material and describe their responsibilities. The contractor shall describe the quality control procedures to be implemented to ensure the integrity of the proposed process.

The contractor is responsible for disposing of all MPPEH and related debris. For planning and estimating purposes, the contractor shall assume [insert number] tons of MPPEH and MEC related debris will require transportation and disposal or stockpiling until the completion of this contract if it poses no immediate threat.

RPM Note: In general, MPPEH is material that is NOT known with certainty to present an explosion hazard, but may contain hidden explosive material, or minor amounts of explosive material. MPPEH must be assumed to present an explosion hazard until it is visually inspected and/or processed, and certified safe. The effective management of MPPEH prevents unauthorized use, transfer, or release of MPPEH from DOD control, transfer or release of MPPEH that will unintentionally present an explosive hazard to either a qualified receiver or the public, and shipment of MPPEH that violates hazardous material transportation regulations. MPPEH handling must comply with NAVSEA OP5, Sections 13-15. Contracts or other legal agreements require compliance with the provisions of NAVSEA OP-5, DOD 4140.62 (series), Material Potentially Presenting an Explosive Hazard (MPPEH), DOD 4145.26-M (series), DOD Contractor's Safety Manual for Ammunition and Explosives, and DOD 4160.21-M (series), Defense Materiel Disposition Manual and DOD 4160.21-M-1 (series), Defense Demilitarization Manual, by all who possess, manage, process, or provide disposition of MPPEH. All of these requirements are rolled up into Section 13-15 of OP-5. The flow diagram at the end of this SOW presents a simplified schematic of how MPPEH is processed.

The RPM is encouraged to discuss site specific conditions with NOSSA/MARCORSYSCOM when deciding how to manage MPPEH. At MRS locations, it is common to find large amounts of casing and munitions parts, which are initially certified inert by an UXO technician and need to be further determined to be clear of residual explosives by surveying all the surfaces. When all the surfaces can not be inspected the material cannot be certified as safe (5X) and is considered hazardous (3X) and the handling requirements outlined in OP5 will have to be met. Some information can also be found in the USACE OE-CX document titled "Corps of Engineers Contractors Ordnance and Explosives (OE), Range

Residue (RR) Inspection, Certification and Final Disposition Procedures," dated April 2003 that describes their preferred methods for safely disposing of MPPEH.

Mag, Flag, & Dig (Magnetometer detection and marking without geophysical mapping followed by intrusive investigation)

RPM Note: The section title above is hyperlinked back to the page where each of the four different Field Work template links are located.

4.1 RI Work Plan

The contractor shall prepare and submit a Draft, Draft Final and Final RI Work Plan, with the required appendices, which incorporate the data requirements and information developed during the planning and scoping task. The RI Work Plan will define project objectives and associated data needs to reach project closeout and describe Data Quality Objectives. The basic RI Work Plan will describe the general methodology for performing the site MEC work, including:

- Site preparation including vegetation removal and removal of surface metallic debris
- Location surveys and mapping
- Geophysical System Verification (instrument verification strip, noise strip, and blind seeding)
- Data Quality Objectives (DQOs)
- Description of anomaly selection procedures
- Description of anomaly removal procedures
- Details of the QC program
- Description of MEC & MPPEH management
- Geographical Information Systems (GIS) and data management

The RI Work plan will include a geophysical investigation plan that describes the equipment, personnel and techniques to be used to collect digital geophysical data at the site. The plan will be detailed and will describe the sensor(s), platform(s), positioning and data analysis methods the contractor will use at each specific removal site(s) to meet the quality assurance and quality control requirements (This could be the accuracies required for an instrument verification strip, blind seeds and for positioning).. Consistent with the requirements of the basic contract, the plan will identify, by name, key personnel responsible for data processing and quality control (QC) and will include a description of their experience and qualifications to perform the work assigned.

RPM Note: The RPM will need to submit an ESS to NOSSA or MARCORSYSCOM for approval prior to field work beginning. The ESS shall be completed in accordance with NOSSAINST 8020.15 (series) Enclosure (3), "Guidelines for Preparing an Explosives Safety Submission."

4.1.1 Site Health & Safety Plan (HASP)

The contractor will prepare and submit a Site Health & Safety Plan (HASP). The HASP will contain an Activity Hazard Analysis (AHA) for each site-specific task to be conducted. The HASP will be appended to the Accident Prevention Plan (APP) that was prepared for the basic contract.

4.1.2 Geophysical System Verification (GSV)

The contractor shall prepare and submit as part of the removal work plan a section on geophysical system verification (GSV) proposed for the site. The contractor will describe the purpose for the GSV (e.g., confirm system performance and ensure that the data quality objectives (DQO) can be met). The contractor shall identify the methods to be used to:

- verify that the geophysical system is performing correctly by measuring the sensor responses of a small number of well-characterized items and confirming that the responses lie within expected parameters (and that the measured locations of the detected items are within requirements) and
- measure the site noise and determine whether targets of interest can be detected reliably to their depth of interest under the site conditions present.
- Emplace throughout the production site Industry Standard Objects (ISOs) in a blind seeding program to confirm production geophysics in the field.

RPM Note: In most instances the complex Geophysical Prove Out (GPO) has been replaced by the GSV. Sites that have a unique requirement for a GPO can reference the* ITRC Technical/Regulatory Guideline for Geophysical Prove-outs for Munitions Response Projects *for details on how to construct and implement a GPO.

The instrument verification test strip concept can be used to verify instrument performance on any site and is an integral part of quality monitoring. For very large sites, it may be cost effective to construct multiple replications of the test strip so that crews can conduct their daily checks without undue transit time. The GSV moves resources from an up-front evaluation of the geophysical systems and their performance to an ongoing verification of the system performance. Utilizing a physics-based approach reduces the logistical burden (e.g., multiple mobilizations, acquisition of surrogates) of the older GPO process, allows use of a smaller plot, and results in greater confidence in the performance of the geophysical project itself. For more information on the GSV, see ESTCP's Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response.

4.1.3 MEC UFP-QAPP

The contractor shall prepare a MEC UFP-QAPP that will address all quality control methods to be used to control MEC activities on the project. The MEC UFP-QAPP will discuss how the contractor intends to implement quality control for all site operations, including QC of equipment and personnel, QC of the data, and the proposed QC personnel and their qualifications. Quality control procedures shall be developed to ensure that quality of geophysical survey data and intrusive sampling for potential MEC anomalies meets the DQO's established by the RI/FS work plan. The MEC UFP-QAPP will be prepared as an Appendix to the RI Work Plan.

RPM Note: See the MEC UFP-QAPP template, the Adak MEC UFP-QAPP example, Adak Technical Management Plan (Work plan), and the Quality Assessment SOW template on the MR Portal for typical PQO's/DQOs, Measurement Performance Criteria, and SOPs. It should be noted that the PQCP in the Adak Technical Management Plan is abbreviated and refers to the Adak MEC UFP-QAPP for supporting details. RPMs are encouraged to use the UFP-QAPP format for their project sites.

The RPM needs to review the QAPP for several factors. The contractor should at a minimum include daily function tests of the equipment and personnel to ensure proper operation and

minimal variances in performance. Refer to Military Munitions Response Actions; USACE Engineer Manual (EM) 1110-1-4009; June 2007, which is a reference which outlines daily and project function checks to be performed and documented by the contractor. The QAPP should also identify that the contractor will repeat collection of data in some percentage of repeated lanes or sections to ensure data repeatability and location repeatability. To ensure there is minimal variation in the data, the data collection team will collect data in an area, with some time separation between the collections of the two data sets. This is often referred to as repeatability. These requirements should be outlined in the QAPP. The RPM should also ensure that there is proper documentation of the QC measures taken at the site.

RPM Note on Government quality assurance requirements: RPMs should be aware that NOSSAINST 8020.15(series) requires that each munitions response project have a QC program administered by the UXO contractor and a QA program administered by an independent, third-party activity. The complexity of the QC and QA programs is dependent on the nature of the project. The Naval Explosive Ordnance Technology Division (NAVEODTECHDIV) has experience, expertise and technically trained personnel in conducting quality assessments and developing the quality assessment reports for munitions response projects. The contact names are listed with the MRP Workgroup. Another alternative is to use a third party contract not associated with the site to perform quality assessment field activities for the Government. Typical aspects of quality assurance may include blind seeding of MEC-like items in the survey area, performing a partial survey on grids cleared by the contractor to confirm the findings, and reviewing documents to ensure consistency between work plans and field applications. The ultimate quality assurance requirements should be determined and budgeted by the RPM. See the Quality Assessment SOW template on the MR Portal for more information.

When developing QC and QA plans it is important to keep in mind that the objective of these plans and their execution is to ensure that agreed on standards of performance for work conducted on the project have been met. The approaches used for verifying this should be consistent with the approach used to conduct the work to avoid setting inconsistent standards for production, QC, and QA (e.g. similar MEC detection systems should be used for production, QC, and QA phases of the project). In addition, QC and QA processes are best scheduled in parallel with production phases of project work and not after completion of productions work. This will allow corrections to be made in production processes, if necessary, and avoid the need for rework of major portions of work that were completed prior to QC or QA review.

4.1.4 Explosives Safety Submission (ESS)

The contractor (or RPM) will prepare and submit an Explosives Safety Submission (ESS) in accordance with NOSSA Instruction 8020.15 (series), Enclosure (3). It is to be coordinated with the installation Explosives Safety Officer and Public Works Planning Department and then submitted to NOSSA/MARCORSYSCOM for their endorsement to the DDESB for their approval prior to the start of fieldwork. The approved ESS [will/will not] be included as an Appendix to the RI Work Plan and the two documents must be consistent. The ESS is the primary explosives safety document at the site.

RPM Note: The RPM will need to submit an ESS to NOSSA or MARCORSYSCOM for approval prior to field work beginning. The ESS shall be completed in accordance with NOSSAINST 8020.15 (series) Enclosure (3), "Guidelines for Preparing an Explosives Safety Submission." NOSSA may take up to a month to review and comment on each draft and the

final ESS. The RPM should also plan on the DDESB review taking at least one month for their review and approval.

4.1.5 Other Relevant Planning Documents

The contractor shall prepare the following additional planning documents, based on knowledge of site conditions provided by the PA/SI and the site-specific RI requirements:

- [insert applicable documents (e.g., Erosion Control, Stormwater Management Plan, etc.]

5.0 RI FIELD ACTIVITIES

5.1 Site Preparation

The contractor shall perform necessary site preparation to adequately support the field sampling methodology outlined in this SOW. [RPM to outline the type and extent of site preparation requirements and/or restrictions]. Procedures and equipment requirements shall be approved by the RPM prior to execution.

RPM Note: Site preparation at an MRS generally consists of brush clearance and surface removal of debris from the areas that will undergo survey and investigation. It may also include a surface sweep for MEC to ensure the safety of the geophysical teams. The RPM should consider the type of growth to be cleared, the regrowth rate, and the cost impacts of site preparation. Brush removal at some sites can be quite costly and may result in ecological damage. If the surface MEC have been removed from the investigation areas, no UXO escorts should be required for the survey teams. If the surface has not been cleared the RPM should work with NOSSA/MARCORSYSCOM to determine if UXO escorts will be required for the investigation team. Some additional language that may be appropriate to include here is: "All MEC teams will be comprised of the appropriately trained personnel to safely and efficiently remove scrap and MEC from the areas designated for removal. The team size, composition and qualifications shall be in accordance with DDESB TP-18."

5.2 Location Surveys and Mapping

The contractor shall perform location recording and mapping using techniques that allow easy conversion/submission of data in the required format e.g., state plane coordinates. The contractor will identify and record the locations of recovered items using a hand-held global positioning system (GPS) UTM, and will record this data in a personal data assistant (PDA).

The contractor may use established control monuments, however, should the contractor select to set any property boundaries or monuments, this work shall be performed by a Professional Land Surveyor licensed in the [insert State]. Existing monument locations will be provided to the contractor. Contractor personnel who are knowledgeable and competent in land surveying and use of surveying equipment may perform grid and/or transect location and layout. The contractor shall prepare all location data and submit following completion of the work. Data must be provided using the appropriate Naval Installation Restoration Information Solution (NIRIS) Electronic Data Deliverable (NEDD) via the web based data checker in accordance with the NEDD SOP. Survey data shall include, at a minimum, a drawing and spreadsheets of survey information. For each site, the drawing shall cover the entire site and will include the list of coordinates for corners, starting, ending, turning locations, reference monuments used in survey, and other pertinent features of grids or transects, to include but not limited to MEC location data including grid number where

found, item number assigned, type of item, location coordinates to nearest foot, and depth below ground surface.

5.3 Detection Equipment for Mag, Flag & Dig

The contractor shall propose a methodology and rationale for performing the detection (Mag), marking (Flag), and [clearance/sampling] (Dig) procedures to support the DQOs and data requirements of the RI/FS. The contractor may propose to map grids or transects, or a combination of these. The contractor shall produce maps of the site that show the major geophysical features (See section 8.3 of the SOW for details).

RPM Note: Some other language that may be appropriate for this section and the ESS includes: "The MEC removal teams will consist of at least one UXOTech III. MPPEH or MEC will be marked and left in place for a further evaluation by the SUXOS or UXOSO on whether the items can be moved within the grid for consolidating for a demolition event. The Schonstedt GA-52Cx, or equivalent, will be used to aid in the search operation."

The RPM with the stakeholders should define what level of geophysical mapping and investigation is adequate to characterize the site. The RPM will need to consider whether the goal of the survey is to locate broad target or disposal areas or specific individual anomalies that could represent MEC. This will focus the goals of the survey. Surveys are typically conducted using grids of 100ftx100ft, but could also utilize transects or other patterns based site specific information. Stakeholder buy-in is critical and leads to greater certainty in the decision making process about the site, cleanup options, and future land use. Obviously, with DGM, the more area mapped, the better the characterization, but also increased costs. So the RPM should work with stakeholders to find the acceptable level of work that will adequately characterize the site within the budget. The costs of a survey are minimal compared to the costs of the intrusive anomaly investigation so consider these factors when scoping your work. In the Management Guidance Principles document, DoD and EPA agreed to a preference for using investigative techniques that provide an auditable, objective record of investigation area and results. This usually means EM and DGPS or something similar as opposed to mag & flag.

RPMs should be aware that there are circumstances where analog metal detection procedures (called mag & flag or mag & dig) may be more appropriate (e.g., OB/OD areas, areas adjacent to targets, etc.). Mag, Flag, & Dig operations are most useful when there is known dispersed contamination of MEC and metal debris where a digital geophysical map would not provide the best level of information. This is sometimes done to clear the surface and to locate major areas of MEC contamination within a site. It must be understood that Mag, Flag, & Dig operations do not produce a digital record of the position of the instrument, operator, or the instrument signal associated with the area surveyed by the MEC technician. Consequently, care must be taken to ensure that adequate QC/QA measures are taken to ensure that AOC's are adequately evaluated and that the performance requirements of the process for removal of MEC and debris metal have been met. An RPM should consider Mag, Flag, & Dig for their site if it is less important to record the position of each anomaly, but only record the significant MEC finds. If Mag., Flag, and Dig operations are chosen as an investigative (or remediation) technique, A QAPP must be developed to ensure that an objective record is maintained of the areas where these techniques have been use.

The contractor shall update and manage the project GIS in NIRIS, or if needed, an export of the NIRIS data using a local machine running ArcGIS or ArcInfo. Any project related spatial data including maps, models and associated collected or created data must then be submitted back to NIRIS according to the NIRIS Non-NEDD Deliverable Submittal Guidelines SOP. This would include daily geophysical data, ordnance related items found during the investigation, positively identified MEC, positively identified archeological sites, environmental sample locations, inaccessible areas such as brush piles, fence lines, areas of bare rock, etc. See Section 8.3 of the SOW for details. The contractor will record the location of all [MEC, disposal pits, etc].

5.4 Intrusive Investigations

The contractor shall implement MEC [clearance/sampling] in accordance with DOD and DON requirements and the approved ESS and RI Work Plan. The contractor will describe in their proposal the method to be used for reacquiring target anomalies from the geophysical data and for performing the investigation and clearance of each target site. For estimating and planning purposes, the contractor is to assume [insert number of anomalies anticipated in a grid, acre, or transect, based on what is being used at your site]. The contractor shall identify in the RI Work Plan the decision criteria for halting or expanding the excavation of anomalies in an area. The contractor will outline the details of the investigation in the ESS for approval by NOSSA/MARCORSYSCOM and ensure that all work descriptions in the RI Work Plan are consistent with the NOSSA/MARCORSYSCOM approved ESS.

RPM Note: The ESS may contain language such as "The UXO Technician will carefully remove enough soil, without disturbing the MEC, to facilitate positive identification or to obtain its identification features. UXO Technicians will make every effort to identify MEC through visual examination of the item for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the fuze conditions can be ascertained. If the condition is questionable, consider the fuze to be armed. The fuze is considered the most hazardous component of a UXO, regardless of type or condition. The SUXOS make final determination of identification of the item and the disposition of the item prior to implementing any disposal operations. Recovered military munitions or MEC will not be moved by personnel unless it is safe to do so. Movement of MEC by hand is authorized only after positive identification and a determination by the UXO Technician III and either the SUXOS or UXOSO and the MEC is safe to move."

The magnetometer survey will see all metal objects and the operator has only a qualitative interpretation of the strength of the anomaly as indicated by the strength of the audio signal or display readout. With Mag, Flag, & Dig, this determination is more qualitative and depends on the experience of the operator. If you are doing sampling at a site, it is important to build in a method where you can investigate areas around MEC findings so that you can characterize the site while you are in the field.

5.5 MEC Management

The contractor shall manage all MEC, MPPEH, and MEC related debris in accordance with DOD and DON requirements and the approved RI/FS Work Plan. The contractor shall describe their proposed methodology for accounting for all MEC items or components encountered from field discovery to point of disposal. This accounting shall include the amounts of MEC, identification and condition, location, orientation and depth of MEC, storage and disposition. The accounting system shall also account for all demolition materials utilized to detonate MEC on site. This accounting

process shall be outlined in the RI/FS Work Plan and included in an appendix to the RI/FS Report. The contractor shall take digital photographs of identifiable MEC found during the investigation, which shall be attached to the MEC locations displayed in the GIS.

RPM Note: Some project teams may also require that all MEC and MPPEH be photographed.

5.5.1 MEC Treatment

RPM Note: The RPM needs to understand that RI field activities that recover MEC will require treatment of the MEC during the investigation phase before the final remedy is selected. This is due to the fact that known MEC that is discovered during the investigation will not be reburied or left in place due to its hazard.

The contractor shall be responsible for the destruction of all MEC in accordance with DOD and DON requirements as described in the approved ESS and RI/FS Work Plan. For planning and estimating purposes, the contractor shall be prepared to dispose of [insert number] items of MEC ranging in size from [insert size of MEC expected at your site]. The contractor shall describe in their proposal the methods, personnel, and equipment they will use to perform disposal of MEC on the site.

RPM Note: The RPM needs to be aware of the process required for any treatment/disposal by detonation of MEC. The RPM should first understand the viable options, which include 1) on-site open detonation, 2) detonation in a contained detonation chamber, (CDC) and 3) transport to an approved facility for detonation. The decision to treat* in situ *or move the MEC item can only be made by the Senior UXO Supervisor or a UXO Technician III team leader. If the MEC item is a UXO, then only active duty EOD personnel can certify them as safe to transport. These last two options are only available if your items are deemed safe to move by the EOD trained personnel. On Navy sites, the Navy EOD may manage the emergency disposal of MEC items (i.e. Adak), and this is for unexpected findings versus a cleanup project. On most sites, (i.e. Mare Island) the contractor performing MEC remedial investigation/action has that responsibility. The RPM will need to decide how this will be handled for your specific site and make sure the requirement is clear in the SOW. This is another case where the stakeholders should be involved in the decision because in many instances, they will strongly object to open detonation as the preferred method of destruction and may request that MEC be destroyed in a CDC. If you have a case where MEC is determined not safe to move, you will need to plan for on-site Blow In Place (BIP) detonation. This contingency should always be built into your RI Work Plan, even if it is unlikely.

Open detonation is cheaper and is the primary practice of military EOD units, though you may need to sample and clean the area after detonation. There are also noise and public notification issues to consider. You may also need to coordinate with your local air board and comply with some substantive requirements. Recall that under CERCLA, we do not have to get permits, but need to meet the substantive permitting requirements. There are many studies that show that well designed detonation does not leave residual chemicals. You will need to work with NOSSA/MARCORSYSCOM to get an ESS approved for any detonation.

The CDC is a commercial unit that has heavy walls to contain to explosive force and it has air treatment units connected to take out particulate. The CDC T-10 is limited to a Net Explosive Weight of 13 pounds of explosives. This limits the size of item that can be detonated. The T-30 is being tested and has the ability to contain 40lbs of explosives. The other limitations of the CDC is that it is quite costly and often unavailable based on use at other sites. It is a favorite of regulators because it is contained. While DDESB has approved use of the CDC unit, you still need to get an ESS approved through NOSSA/MARCORSYSCOM and then DDESB for your site prior to its use. The CDC is too expensive to remain on site for the duration of the project and typically will be mobilized at the end of the project for just the number of days needed to complete disposal of the MEC. During the collection period and until the CDC can be mobilized, any munitions recovered will have to be stored in a NOSSA/MARCORSYSCOM approved, secured storage area. An empty, site approved magazine in an ammunition facility is an excellent resource when it is available. If not, the contractor will have to site, install, maintain and remove a temporary storage facility that may have more than one magazine due to ammunition compatibility storage requirements. All of these issues should be discussed with the stakeholders with the goal of reaching a sensible solution. Whatever the decision, the information about managing MEC and treatment/disposal operations will have to be included in the ESS.

5.5.2 Material Potentially Posing an Explosives Hazard (MPPEH) Management

The contractor shall be responsible for the disposition of all MPPEH in accordance with the approved RI Work Plan. The contractor shall identify in his proposal the methods and equipment to be used to inspect, certify, verify, demilitarize, and dispose of MPPEH from the site. The contractor shall identify the positions of personnel who will be involved in inspecting, certifying and verifying the material and describe their responsibilities. The contractor shall describe the quality control procedures to be implemented to ensure the integrity of the proposed process.

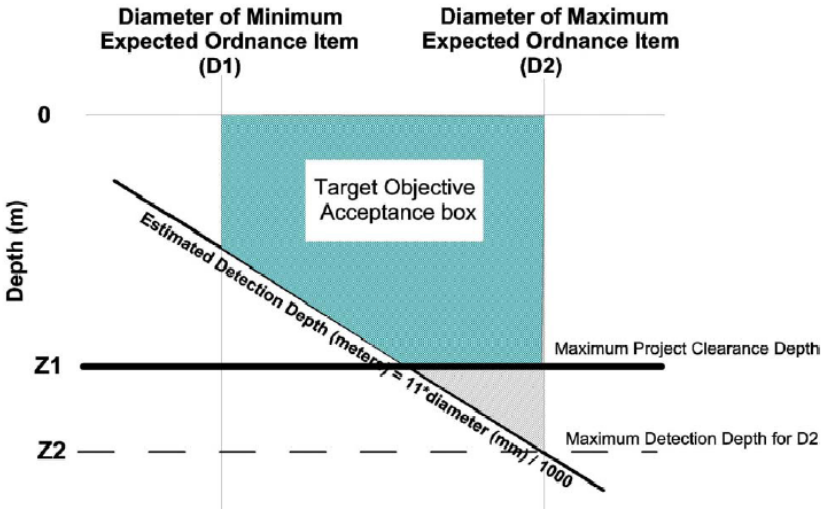
The contractor is responsible for disposing of all MEC related debris. For planning and estimating purposes, the contractor shall assume [insert number] tons of MEC related debris will require transportation and disposal or stockpiling until the completion of this contract if it poses no immediate threat.

RPM Note: In general, MPPEH is material that is NOT known with certainty to present an explosion hazard, but may contain hidden explosive material, or minor amounts of explosive material. MPPEH must be assumed to present an explosion hazard until it is visually inspected and/or processed, and certified safe. The effective management of MPPEH prevents unauthorized use, transfer, or release of MPPEH from DOD control, transfer or release of MPPEH that will unintentionally present an explosive hazard to either a qualified receiver or the public, and shipment of MPPEH that violates hazardous material transportation regulations. MPPEH handling must comply with NAVSEA OP5, Section 13-15. Contracts or other legal agreements require compliance with the provisions of NAVSEA OP-5, DOD 4140.62 (series), Material Potentially Presenting an Explosive Hazard (MPPEH), DOD 4145.26-M (series), DOD Contractor's Safety Manual for Ammunition and Explosives, and DOD 4160.21-M (series), Defense Materiel Disposition Manual and DOD 4160.21-M-1 (series), Defense Demilitarization Manual, by all who possess, manage, process, or provide disposition of MPPEH. All of these requirements are rolled up into Section 13-15 of OP-5. The flow diagram at the end of this SOW presents a simplified schematic of how MPPEH is processed.

The RPM is encouraged to discuss site specific conditions with NOSSA/MARCORSYSCOM when deciding how to manage MPPEH. At MRS locations, it is common to find large

amounts of casing and munitions parts, which are initially certified inert by an UXO technician and need to be further determined to be free of residual explosives by visually inspecting all the surfaces. When all the surfaces can not be inspected the material cannot be certified as safe (5X) and is considered hazardous (3X). Some information can also be found in the USACE OE-CX document titled "Corps of Engineers Contractors Ordnance and Explosives (OE), Range Residue (RR) Inspection, Certification and Final Disposition Procedures," dated April 2003 that describes their preferred methods for safely disposing of MPPEH.

Figure 1 Estimated Detection Depth



Notes:

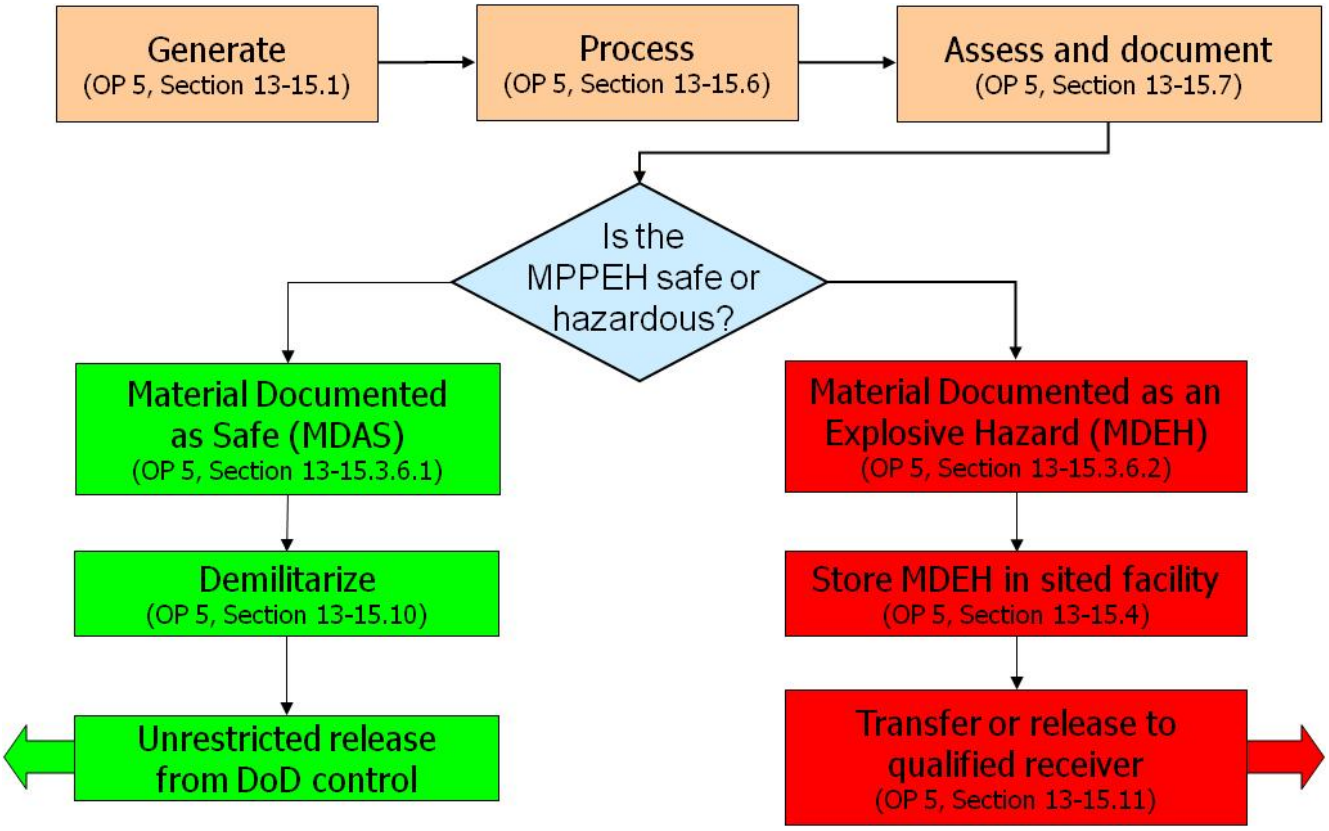
- Depth = depth to center of item mass
- Diameter = diameter of minor axis
- Depth and Diameter are common length units

Examples:

- 20mm detection depth = 0.22m (8.7 in)
- 155mm detection depth = 1.7m (5.6 ft)
- Mk 82 detection depth = 3 m (9.9 ft)

Source: U.S. Army Corps of Engineers, Data Item Description MR-005-05, "Geophysical Investigation Plan".

MPPEH Management



REMOVAL TECHNOLOGIES

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Hand Excavation	**Medium**: This is the industry standard for MEC recovery. It can be very thorough and provides good data on items collected.	**High**: Hand excavation can be accomplished in almost any terrain and climate. Limited only by the number of people available.	**Average**: As the standard by which all others are measured.	Probe, Trowel, Shovel, Pick Ax	Locally available and easily replaced tools
Mechanized Removal of Individual Anomalies	**Medium**: Used in conjunction with hand excavation when soil is too hard causing time delay during hand excavation. Method works well for the excavation of single anomalies or or larger areas of heavy ferrous metal concentration.	**High**: Equipment can be rented almost anywhere and is easy to operate. Allows excavation of anomalies in hard soil and to clear large areas with substantial metal concentration.	**Low**: In hard soil this method has a lower cost than that of having the single anomalies hand excavated.	Tracked Mini-Excavator, bull dozers, loaders, etc. Multiple manufacturers	Easy to rent and to operate
Mass Excavation and Sifting	**High**: Process work very well in heavily contaminated areas. Can separate several different sizes of material allowing for large quantities of soil to be returned with minimal screening for MEC.	**Medium**: Earth moving equipment is readily available. However, armoring is not as widely available. Equipment is harder to maintain and may require trained heavy equipment operators. Not feasible for large explosively-configured munitions.	**High**: Earth moving equipment is expensive to rent and to insure and has the added expense of high maintenance cost as well.	**Earth Moving Equipment:** Many brands of heavy earth moving equipment are available including excavators, off road dump trucks, and front-end loaders. **Sifting Equipment:** Trommel, Shaker, Rotary Screen from varying manufacturers**.**	Can be rented, armor installed, and delivered almost anywhere. Significant maintenance costs

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Mechanized Soil Processing	**High** Mechanized processing systems are a proven technology for removing MEC and other solid materials from soil.	**High** Equipment and references for planning and operations are readily available.	**Medium - High** Acquisition and operation of these systems is initially expensive, though savings may be realized for large economy of scale efforts.	A wide variety of equipment and suppliers are available for shaker and trommel systems.	Use of magnetic technology (rollers) can augment capabilities for some MEC applications.
Magnetically Assisted Recovery	**Low**: Primarily used in conjunction with mass excavation and sifting operations. Can help remove metal from separated soils, but does not work well enough to remove the need to inspect the smaller size soil spoils. Magnetic systems are also potentially useful to help with surface clearance of frag and surface debris.	**High**: Magnetic rollers are easily obtained from the sifting equipment distributors and are designed to work with their equipment.	**Low**: This method adds very little cost to the already expensive sifting operation.	Magnetic rollers or magnetic pick ups are available from many manufacturers of the sifting equipment noted above.	Installed by sifting equipment owners.
Remotely Operated Removal Equipment	**Low**: Remotely operated equipment reduces productivity and capability of the equipment. Method is not widely used and is not yet proven to be an efficient means of MEC recovery.	**Low**: Uses earth moving equipment, both mini-excavator type and heavier off road earth moving equipment. Machinery is rigged with hydraulic or electrical controls to be operated remotely.	**High**: Has a combined cost of the base equipment plus the remote operating equipment and an operator. Remote operation protects the operator, but can create high equipment damage costs.	Many tracked excavators, dozers, loaders and other equipment types have been outfitted with robotic remote controls.	EOD robots are almost exclusively used for military and law enforcement reconnaissance and render-safe operations. They were not evaluated for MEC applications.

TREATMENT TECHNOLOGIES

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Blow in Place (BIP)	**High** Each MEC item is individually destroyed with subsequent results individually verified (QA/QC).	**Medium to High** Field-proven techniques, transportable tools and equipment, suited to most MEC environments. Public exposure can limit viability of this option. Engineering controls can further improve implementation.	**Medium to High** Manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled.	Electric demolition procedures, non-electric demolition procedures	Disposition of resultant waste streams must be addressed in BIP operations planning. Waste streams produced by BIP are not contained and thus not as easily dealt with. As regulatory agencies become more involved in MEC projects, this may yield higher life cycle cost for waste (for characterization, treatment and disposal) than technologies that do contain the waste streams.

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Consolidate and Blow	**High** Techniques recently developed and refined in Iraq are providing documented successes. Use of donor munitions also proving effective. Limited in use to munitions that are “safe to move”.	**Medium** Generally employs same techniques, tools and equipment as BIP. Requires larger area and greater controls. Most engineering controls not completely effective/applicable for these operations.	**Medium** Manpower intensive, may require MHE spell out this acronym for large scale operations	Electric demolition procedures non-electric demolition procedures forklifts and cranes	Disposition of resultant waste streams must be addressed. Increased areas require additional access and safety considerations. Waste streams produced by consolidated and blow are not contained and thus not as easily dealt with. As regulatory agencies become more involved in the projects, this may yield higher life cycle costs for waste (for characterization, treatment and disposal) than technologies that do contain waste streams. This could be of even greater concern in consolidate and blow operations where there will be more residual generated and thus potentially greater concentrations of regulated analytes
Contained Detonation Chambers - Stationary	**High** Chambers successfully contain hazardous components. Current literature reviewed	**Low - Medium** Stationary facilities typically must meet regulatory and construction standard for permanent/semi-permanent	**High** Siting and construction required. Low feed rates = more hours on site. Significant requirements fo	Typically designed on case-by-case basis.	System cleaning and maintenance usually requires PPE and worker training. Probable permitting

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
	shows containment up to 35 lbs (assume NEW). Commonly used for fuzes and smaller explosive components.	waste disposal facilities. Service life and maintenance are issues. Requires additional handling of MEC. Flashing furnaces have low feed rates due to safety concerns. Produces additional hazardous waste streams.	maintenance of system		issues with employment of technology.
Contained Detonation Chambers - Mobile	**High** Chambers successfully contain hazardous components. Current literature reviewed shows containment up to 35 lbs (assume NEW). Commonly used for fuzes and smaller explosive components.	**Medium - High** Designed to be deployed at the project site. Greatly reduced footprint compared to stationary facilities. Service life and maintenance are issues. Requires additional handling of MEC. Flashing furnaces have low feed rates due to safety concerns. Produces additional hazardous waste streams	**Medium - High** Possible Construction required (e.g., berms and pads). Low feed rates = more hours on site. Significant requirements for maintenance of system	Donovan Blast Chamber Kobe Blast Chamber	System cleaning and maintenance usually requires PPE and worker training. Possible permitting issues with employment of technology (on other than CERCLA/FUDS sites). The fact that the waste stream is contained and is more easily dealt with (even when hazardous) is an advantage both in terms of public perception and in life cycle cost.

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Laser Initiation	**Low- Medium** Still in development, though currently deployed in Iraq for testing. Tests show positive results for 81mm and below, with reported success on munitions up to 155mm. Produces low-order type effect; subsequent debris still requires disposition.	**Low - Medium** MEC targets must be exposed/on surface for attack by directed beam. GATOR Laser System (Diode Laser Neutralization via Fiber-Optic Delivered Energy) does not require line-of-sight within approximately 100m. GATOR system does require approach and placement of fiber-optic cable at appropriate position of MEC. Laser systems still addressing power, configuration, transportability and logistics issues.	**Low – Medium** Greatly reduced manpower; added equipment, transportability and logistics concerns; no explosives required by system	ZEUS-HLONS GATOR LASER Thor	Offers added safety through significant standoff (up to 300m). (note: acceptable safety standoffs must be evaluated for specific MEC and scenarios). ZEUS prototype deployed/employed in Afghanistan (2003). Waste streams produced by laser initiation are not contained and are thus not as easily dealt with. As regulatory agencies become more involved in MEC projects, this may yield higher life cycle costs for waste (for characterization, treatment and disposal) than technologies that do contain waste streams. This may be of even more concern with laser initiated detonation/deflagration as residual contamination may be higher than with traditional BIP. Low order detonations could potentially yield greater environmental contamination than successful BIP operations.

RESIDUAL PROCESSING TECHNOLOGIES

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes
Chemical Decontamination	**Low to Medium** Great variance in chemicals required to decontaminate various MEC (e.g., propellants, pyrotechnics, explosives). Difficult to test for effectiveness of many methods. May generate additional waste streams (some hazardous).	**Low to Medium** Requires containment of multiple hazardous materials (e.g., MEC and solvents). May require emissions controls. Worker training and PPE typically required.	**Medium to High** Specialized manpower, containment requirements, additional waste stream processing.	Supercritical Water Oxidation (SCWO) Photocatalysis Molten Salt Oxidation (MSO)	
Flashing Furnaces	**High** Furnaces are designed to contain hazardous components. Methods are proven means of attaining high degrees (5X) of decontamination. Commonly used to destroy and decontaminate fuzes and smaller explosive components.	**Medium** Typically stationary facilities. Service life and maintenance are issues. Requires additional handling of MEC. Flashing furnaces have low feed rates due to safety concerns. Produces additional hazardous waste streams.	**High** Possible Construction required. Low feed rates = more hours on site. Maintenance of system.	Rotary kiln incinerator Explosive waste incinerator (EWI) Transportable flashing furnace	System cleaning and maintenance usually requires PPE and worker training. May require permit to deploy technology.
Shredders and Crushers	**Medium** Renders small arms, fuzes and other components inoperable. Residue	**Low to Medium** Typically stationary facilities. Service life and very high maintenance are expected. Requires additional handling of	**Medium to High** Specialized equipment and operators. High maintenance. Additional waste stream	Shred Tech ST-100H Roll-Off (vehicle mounted)	Disposition of resultant waste streams must be addressed.

	will typically still require additional treatment to achieve higher decontamination levels.	MEC.	processing.		